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Constructors' versus Designers' Pay

SHOULD engineers engaged in construction be paid more than those engaged in design? That question is raised by a recent tentative schedule of salaries for highway engineers. Those in charge of construction were to be paid more than those who designed and maintained the selfsame roads and bridges. Is this as it should be? Does it require more ability and experience to build a given job than to design it? Can maintenance of a system of highways be left to men of lower caliber than those who build it? Is less talent required for bridge designing than for the construction of bridges and of highways? *What is the opinion of the profession on these questions?*

Order or Anarchy

IT WILL not require many demonstrations like that at Boston to bring the country to a sober realization of the dangers of radicalism. Remembering injustices of the past, few there are who have not rejoiced that a better day was coming for the worker. In our sympathy we have been apt to condone much, realizing that those newly come to a realization of power have not had the sobering influence of long responsibility. Our condonation has been weakened by the rise of unreasonableness, and our perspective is entirely restored by a shock such as that occasioned by the Boston policemen's strike. If the country were to condone that strike, we should be on the verge of Bolshevism. Fortunately, the reaction has been quick and positive. The country will have none of the excesses of Boston. The striking policemen have been branded as deserters, a term which alone fits the case, unless the affair be termed a mutiny. The issue fundamentally is whether class interest can be allowed to stand against that of the public. The answer is "No," and "No" will be the answer, we confidently believe, when any class seeks its personal ends to the detriment of the interests of all the rest of the people.

Federation of Labor on Trial

THE Boston policemen's desertion became, above all, a test of where America stood on the issue of orderly government versus anarchy. But it involves another test. It has put the American Federation of Labor on trial. That body, despite the excesses incident to continued contest, has had the confidence of a great many people, even among the managers of industry. It has, on the whole, tried to stay within sound lines, even though it indorsed and supported demands, by its subordinate bodies, which business men believed unreasonable. It has been counted on to stand for law and order, for the peaceful rather than the revolutionary method of arriving at its goal. The radicals have been making progress in the organization. Have they captured it? Will the federation stand for violence in future or adhere to the peaceful methods which have brought it to its present great power? The evidence is discouraging. Mr. Gompers could have scored a triumph for his organization and won for it countrywide approval and support had he taken a firm stand, had he declared the organization opposed to desertion by the legally constituted guardians of order. He has avoided the issue. He regrets the occurrence. He temporizes with the situation by counseling the policemen to return to their posts until the matter can be discussed at the President's coming industrial conference. He has made a mistake from the standpoint of the popular support which the federation needs in order to continue its progress. He has made a mistake from the standpoint of the public good. We hope that the federation may yet come to its senses and ally itself with order rather than anarchy.

Design Records for the Operating Force

DESIGNING engineers' functions too often cease with the making of the designs, though more and more it is being recognized that their work does not stop until the construction is finished; in some cases their field extends into the operating period. Fay, Spofford & Thorndike, of Boston, in their design of the Boston Army supply base have recognized their obligation to the operator by preparing information necessary for efficient operation, in the form of bound volumes, which are part of the equipment of the terminal. These books, which aim to include all pertinent data on the base as it was turned over to the operators, are entitled "Utility Atlases and Operating Plans," and cover the following subjects: Topographical plans, elevations of buildings, roads and railroads, water, sewers and drains, heating and electrical. On the drawings are included full dimensions; that is, clearances, distances, etc., but not the complete design dimensions. The location of all valves, pipes, wires, conduits, etc., and other hidden details which conceivably the operator may at some time want to reach are included. Too often such information is lost once the design is finished, and the operator of the plant must waste time and effort in trying to locate certain fixtures or to establish certain dimensions, the records of which could readily be preserved by such additional work as has been done in this case. The procedure is a useful extension of the designing engineer's work.

Coming Safety Congress

THERE has just come to hand the elaborate program of the eighth annual Safety Congress, to be held under the auspices of the National Safety Council in Cleveland, Oct. 1–4. The variety of subjects covered is a revelation to those who have not followed the progress of the safety movement. There will be no less than

twenty sessions at Cleveland. Four of them are general meetings, six are general round-tables, and the remainder are sectional sessions, devoted to special problems. The automotive, cement, chemical, electric-railway, metal-working and mining industries, to mention only a few, are to have special sessions. The construction section is to have two meetings, under the chairmanship of L. D. Woedtke, director of safety of Fred T. Ley & Co., Springfield, Mass. Such pertinent topics as whether accident prevention in construction is a source of profit, or a hobby, and how the small contractor can reduce accidents, will be taken up. Obviously, these sessions will be of primary interest to contractors and to construction engineers. Nevertheless, in their bearing upon the cost of work, they have an interest for the whole profession. Aside from the immediate bearing upon the work of the civil engineer, the meeting furnishes inspiration to those who follow progress in our industrial organization. It is a clear indication of the advance that has been made in the betterment of working conditions, and is an augury of still better conditions in the future. In addition to the sessions noted above, there will be an exhibit at which leading manufacturers of safety devices will be represented.

Germany Increasing Production

FROM various quarters comes word that Germany is settling down to its industrial work quicker than any other of the warring nations. Lieut.-Col. Fred H. Wagner, recently returned from a nitrate study for the Government, had this to say in a recent address in Baltimore: "Germany is today the sanest nation in Europe. Except in a few isolated places, there are no strikes. They are quietly preparing to flood the world with cheap goods. The German workmen are working 11 hours a day for eight hours' pay. In France the workmen are working three hours a day for eight hours' pay." This general view is borne out by a report from George Renwick, the English correspondent, on his return to Germany last week after an absence of two months. "The most striking change," he says in a cable message to the *New York Times*, "is undoubtedly the noteworthy evidence of greatly increased and increasing industrial productivity, while there is also, I believe, a much saner spirit throughout the country. . . . The country is getting busier every day. On all hands one sees evidence that Germany is putting her shoulder ever more determinedly to the deeply rutted wheel." He then describes the great quantity and variety of goods *at low cost* found for sale in the shops, and contrasts that condition with the scarcity of two months ago. We have no desire to go back to the popular pre-war habit of holding up Germany as a model, but just at present we can learn something from the way the Germans are increasing production.

Six-Hour Day, Five-Day Week

CONTRASTED with the spirit in Germany, alluded to above, is the action of the United Mine Workers of America. Last week they declared not merely for nationalization of the coal mines, but for a *six-hour day* and a *five-day* week. That way lie starvation and industrial wreckage, unless during the actual working period efficiency is tremendously increased. The spirit of the times, though, gives no hope for increased efficiency.

Freight Terminal Design a Traffic Problem

THANKS mainly to the efforts of the manufacturers of handling machinery, there has been a growing appreciation of the value of the rapid handling of material. Every phase of engineering work has had part in this revival, from the substitution of the concrete mixer for the man, shovel and board, to the development of the mammoth handlers of bulk material on the Great Lakes. Along with everything else, the freight terminal, either marine or rail, has been improved by the substitution of machines for men. In the development of the tractor trailer alone is the germ of a revolution in handling package freight.

In spite of this increase in mechanical efficiency, the freight terminal, especially the large marine terminal, has not increased proportionately in its freight-handling capacity. Some exceptions might be cited, but as a rule the loading and unloading from warehouse to ship or car is not today very far in advance of what it was two decades ago. The trouble seems to have been that the designers of these terminals and their machinery have not had sufficiently in mind the conception of the whole terminal as a freight-handling unit. Until the engineers connected with the Army supply bases started their designs, it is fair to say that the problem had not been confronted from what we may call the engineering viewpoint.

That problem is essentially one of traffic. The elements of the material handling are only incidental. Just as in a rapid-transit system the power house, the roadbed and the rolling stock must be of maximum efficiency, so in the freight terminal the machinery must be equal to any burden put upon it. But the success of a rapid-transit system depends on the manipulation of its trains so that there is a flow of passenger accommodation without interference and without stop. So in the freight terminal the big problem is to get the material out of the way so as to let the new material take its place, and to utilize the equipment to full capacity. This requires the visualizing of the terminal as a whole, and the working out of the design so that every item of freight to be moved proceeds on its appointed path from source to destination in the shortest possible time and with the least possible effort, and at the same time does not conflict with any similar unit on its appointed way.

To do this properly requires the engineering mind and engineering methods. The practical warehouse man is not apt to measure up to the task. Generally, he is too close to his job to see it as a whole. Too frequently his experience blinds his appreciation of methods with which he has not worked, and almost invariably he is more concerned with the rapid and efficient movement of small batches of goods than with the maximum efficiency of the whole plant. His value is in his knowledge of the various steps that go to make up terminal operation, and that knowledge the engineering designer must utilize as much as possible.

As pointed out in the article on another page, descriptive of the freight-handling methods proposed in the Brooklyn Army Base, there has as yet been no opportunity to test the designs of the great Army terminals. It should be obvious from the description of how the Brooklyn design was developed that success or failure depends as much on scientific operation as on effective design. The best the designer can do is to

prepare the plan so that a controlling head, with his finger on every detail of the huge plant, can dispose of various units so that each moves at its maximum capacity to its designed destination, without interference. This requires superior executive ability, the exercise of which it is hoped will be witnessed at some of the Army bases as soon as they are put into practical operation.

Increased production is beyond question the salvation of the future. Here is one way in which some engineers can bring it about, for in the lagging of freight in transit, and particularly in the wasted time of huge ships at docks, there has been an economic loss which scientific design and operation can much reduce in the future.

An Opportunity for Skillful Design

SOME weeks ago we spoke of the waste of highway-bridge investment chargeable to corrosion of the steel due to pocketing of dirt and moisture. Now that an engineer details a specific instance of repairs necessitated by such corrosion, the subject receives worthwhile emphasis. Attention is directed to certain conditions that particularly favor abnormal corrosion.

In a large measure the liability to pocketing has been overlooked heretofore, or, at least, its harmful results have not been clearly recognized. But, in addition, certain recognized corrosion troubles have not received adequate treatment. It has long been known, for example, that end bearings of highway bridges are favorite places for dirt accumulation and concentrated rusting, yet at no time was anything done in the way of improvement except in some cases providing more space around the bearings in order that the wind might keep them clear of litter. In the repair work now described, a determined attempt at cure has at last been made. The method used is radical and extremely suggestive: Incasing the bearings in concrete blocks with a thin parting at the plane of motion, and using a sliding plate in place of rollers. Critical study by other highway bridge engineers should soon develop the merits and weaknesses of this design.

Those opportunities for intensive corrosion that have been generally overlooked are more important, however. In the main, they depend on the floor construction. Plank floors, a type we shall doubtless long continue to use, are unfortunately very efficient devices for distributing moisture over the steelwork beneath them, and for filling the seams between metal and wood with water films. This fact has not been definitely realized in the past. Nor has the special likelihood of pocketing and rusting at the narrow clearances between truss web members and decking been appreciated. When the losses resulting from these conditions are fully realized, engineering skill can provide the means for preventing the damage; thus, a reasonably tight floor, provision of floor drainage, elimination of spiking strips, and the like, will go far toward eliminating the floor trouble. The first essential is that the seriousness of the present trouble should be appreciated.

What has been said does not apply unreservedly to bridges crossing railway tracks. Here the problem is more complicated, involving both moisture from above and corrosive gases from below. We have previously had occasion to refer to the possibility that complete concrete protection of the lower portions of the steelwork might ultimately be found necessary in such locations. But the simpler problem of the ordinary highway bridge is in more immediate need of attention, in view of the vast number of such structures and the absolute dependence of road traffic upon them.

Electrolytic Sewage Treatment Not Yet an Established Process

THIRTY years of experiments and demonstrations, with only a few small working plants built and most of those abandoned—such in epitome is the record of the electrolytic process of sewage treatment. The story up to 1912 was told in detail in *Engineering News* of Mar. 21 of that year. In the same issue the first of the plants at Oklahoma City was described. Both plants have since been abandoned. Meanwhile two new processes have been brought forward and one of them—the "direct-oxidation" system, in which electrolysis is only one of a half-dozen elements—has been the subject of various demonstration tests, at Elmhurst, L. I., and Decatur, Ill., a number of reports and no little controversy. (On the Elmhurst plant, Borough of Queens, New York City, see *Engineering Record* of Sept. 12 and 19, 1914, pp. 292 and 315, and Oct. 17, 1914, p. 429; also *Engineering News* of July 13, 1916, p. 91. On the plant at Decatur, Ill., see *Engineering Record* of Oct. 17, 1916, p. 455, and Nov. 11, 1916, pp. 577 and 596.)

The direct-oxidation process has again been brought to the front by independent reports on a demonstration plant at Easton, Penn., both abstracted in this issue, and by pending proposals for permanent plants at Phillipsburg, N. J., and Allentown, Penn. Interest in the subject is heightened by the refusal of the New Jersey State Department of Health to approve the Phillipsburg plans last March and by a conditional approval on Aug. 12 (see news page). These current phases of the electrolytic process, together with the fact that, based on one of the Easton demonstration tests the Franklin Institute has awarded one of its gold medals to the promoter, make desirable a supplementary review of the electrolytic process, although no permanent plant of that type has yet been built.

In the review already mentioned it was shown that electrolytic treatment had not yet been established as a reliable and economic process of sewage treatment and that there was then no promise that it ever would be. At the same time, the possibility of success was recognized. Has this been realized to such an extent as to warrant its adoption by a city without farther investigation by wholly disinterested engineers? It seems not. Although both of the Easton reports declare that a satisfactory effluent was produced, they leave cost and the sludge problem in doubt and raise other questions that need to be answered. Until all these doubts have been removed by practical experience at several city-operated plants this particular method must be considered as being on probation.

The Pennsylvania State Department of Health report gives the direct-oxidation process more standing than it has had heretofore. The Franklin Institute report adds to the meager test data on the process. The test data of the two reports are printed elsewhere nearly in full, in order that readers of *Engineering News-Record* may draw their own conclusions from them, and the judicious conclusions of the Pennsylvania report are summarized.

It has been said that both reports leave the sludge problem in doubt. Of the Pennsylvania report this is true only to the extent that the test as made by the promoter seemed to take sludge disposal for granted. The report forcibly points out that the sludge problem is one to be reckoned with, that the bill will be high, and that the sludge might be a nuisance. The Franklin Institute report practically ignores sludge disposal.

It should be made plain, before going further, that the Landreth direct-oxidation process is not, strictly speaking, an electrolytic process, and that its promoter does not claim that it is such. It has been called a lime-electrolytic process. But that is not all. It is *a simultaneous combination of* (1) *lime precipitation*, (2) *electrolysis and* (3) *mechanical agitation, preceded at Easton by* (4) *coarse screening*, (5) *grit chamber action and* (6) *fine screening and followed by* (7) *sedimentation, after which the sludge remains for treatment and disposal.*

The last point is so important as to warrant first consideration in the further discussion. Every student of sanitary engineering knows that the sludge problem is the crux of sewage disposal, wherever what may be termed complete treatment is required. And every close student also knows that for twoscore years lime and other chemical precipitation methods have been avoided in new plants and abandoned where possible in old ones, because any efficient precipitant adds immensely to the volume of sludge. In the Pennsylvania tests, with the operation of the plant entirely in the control of the promoter, 3700 lb. of lime per 1,000,000 gal. of sewage was used. This is an excessively heavy dose and must produce an immense volume of sludge for treatment and disposal. In the Franklin Institute tests a much lower lime rate was used, but enough to add largely to the sludge volume—yet sludge disposal is practically ignored!

The vital question as regards the demonstration plant at Easton, or any other new process or combination of old processes, is What can it do that well proved systems of sewage treatment cannot do, and what is the comparative cost? Neither test shows that the Easton plant produced an effluent better than could be obtained by other methods or combinations of sewage treatment. An excessive cost is indicated in the Pennsylvania report, and no full cost estimates are given in the Franklin Institute report. The cost and most of the other test figures in the two reports are not directly comparable. The Franklin Institute's attempts to compare treatment results and costs for the Landreth process with those for other processes are not satisfactory, to say the least. The promoters use of 3700 lb. of lime per 1,000,000 gal. at Easton and heavy lime doses in some of his earlier tests to obtain maximum results, and his claims that much lower rates are sufficient and would reduce costs, do not go well when brought together. It is a case of high dosage for treatment results and low dosage for cost estimates.

The engineering division of the Pennsylvania Department of Health does well to advise that no city adopt the Landreth process without first making careful studies of its availability and cost compared with other processes. It also suggests that further investigations of the Landreth process might well be made. If the latter were to be done, not only should comparative tests of the Landreth and other processes be undertaken, but the elements and various combinations of the elements of the Landreth process should be compared with themselves, with the entire process and with other processes. Moreover, such tests should not be made in sequence, and then assembled for comparison, as was the case with the Franklin Institute tests to compare (1) lime and paddles (2) electrolysis and paddles, and (3) lime, electrolysis and paddles with one aonther. Instead, they should be made in parallel.

The process must still be regarded as in the experimental, or, at best, the demonstration stage. As such, one cannot help wondering why it should have received a gold medal of the Franklin Institute, if such a medal has real significance. It is to be hoped that no municipality will be misled into thinking that because a medal has been awarded for an "advance" in one of the arts any guarantee is afforded of efficiency and economy when the process comes into every-day use.

It should be remembered that the Webster process, tested as a pioneer in 1889 on London sewage, was abandoned by the City of Ipswich, England, after some years of use; that several Hermite plants, installed in Europe, have been given up; that the Woolf plant at Danbury, Conn., was shut down after a long fight in the courts; that the two Harris or Lautzenheiser plants at Oklahoma City have been abandoned. Apparently the only electrolytic plants treating municipal sewage at city expense are those at Santa Monica, Calif., and at Durant, Okla., of the same type as the abandoned plants at Oklahoma City. Reports from Santa Monica indicate that the plant there has little effect on the sewage and that more could be done with less expense by ordinary chlorination, especially as pumping would not then be necessary.

It is unfortunate but true that much of the history of attempts at sewage electrolysis in America affords unpleasant instances of vigorous promotion of unproved processes. Too many engineers, chemists and bacteriologists, for the most part quite unfamiliar with the nature and objects of sewage treatment, have lent themselves—it may be unwittingly, but, if so, perhaps all the more inexcusably—to aid unproved methods of sewage treatment. It is high time that all this mischief was stopped. It stands less chance of being attempted now than it did some years back because so many states now have efficient boards of health with engineers and laboratories to protect the municipalities but the temptation will doubtless persist and moral forces must be brought against it.

The unenlightened city official too often pins his faith to guarantees of the promoter-contractor. Such guarantees are generally drawn weakly from the municipal side. Rarely if ever do they extend beyond a short test period. Oklahoma City had guarantees on its first and presumably on its sewage-treatment contract, but to what avail?

Finally, it should not be inferred that opportunity is lacking for technically competent experimentation in the field of sewage disposal. Although there are a number of processes available to choose from, the cost of full sewage treatment is high, and there are many unsolved problems and hopeful possibilities. New methods and devices of proved or promising worth would be welcomed by engineers, state health officials and municipalities if presented solely on their technical and financial merits.

Drainage Works of the Rio Grande Irrigation Project

Elements of Design, Methods of Ditch Construction With Dragline Excavators on Caterpillar Tractors, and Details of Cost—Over 15,000,000 Cubic Yards of Excavation Involved at Cost of About $3,500,000

By J. L. Burkholder
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SEEPAGE is a menace to the practice of irrigation farming. In recent years many of the larger projects have experienced serious seepage, and these problems have forced attention to this phase of irrigation.

Fortunately, many irrigation projects have excellent natural drainage, and the seepage or waterlogging has been confined to areas of limited extent. The Rio Grande project of the United States Reclamation Service furnishes a notable example of the opposite case. Approximately 70% of the gross area of this project had become either affected by seepage or was in immediate danger of becoming affected in 1917, prior to the beginning of drainage construction work. Extensive areas showed alkali incrustations. Many fields were too wet for cultivation and in many localities even the adobe homes of the native Mexicans were destroyed by caving of the overwet walls. Work is now progressing on an extensive drainage system comprising 316 miles of deep, open drains involving excavation estimated to aggregate 15,362,000 cu.yd. and to cost $3,374,000, or about $10,700 per mile, including both direct and indirect charges. The unit cost for excavation alone is assumed as 15c. per cubic yard. The work is being done by dragline excavators.

The seepage was caused by a general and rapid rise of the ground-water table, due to conditions over which the Reclamation Service had little or no control. Comprehensive measurements were made of this rise, and the resulting information was furnished to the water users, but little credence was given to early predictions made by the engineers that extensive areas would become waterlogged. Moreover, no extensive relief measures could be planned until the water users entered into contract for the repayment of the cost of drainage. Thus, with the actual appearance of seepage much preliminary work was necessary before the Reclamation Service could legally begin drainage construction.

The Rio Grande project is located on the Rio Grande River in New Mexico and Texas, as shown on the small sketch map forming a part of Fig. 1. It receives its water-supply from the river for which it is named, and the full supply depends on the storage water impounded by the Elephant Butte reservoir, which has a capacity of 2,600,000 acre-ft. of water. The project comprises a gross area of approximately 200,000 acres which lie in three valleys which are named, from north to south, the Rincon, the Mesilla and the El Paso. The El Paso and the Mesilla Valleys, wherein the principal area lies, are separated by a rocky pass and by the higher lands on which the City of El Paso, Tex., is located. The approximate average elevation of the irrigable area is 3600 ft. above sea level. Approximately 60% of the cultivated area is devoted to the production of alfalfa.

The irrigable area within these valleys is defined by the river bottom lands and lies in a strip from one to five miles in width skirted by rather abrupt bluffs and foothills. The threads of the valleys slope from 4 to 5 ft. per mile and the ground surface is generally flat, except where broken by small hills of blow sand or cut by old river washes.

The river meanders through the valley flood plains and has an average length almost double that of the valley itself. At intervals the channel pinches against the bluffs, forming the irrigable area into natural parcels or units. Such units control, in some measure, the general plan of both the irrigation system and the drainage system, by defining the necessary canal diversions and the outlet points for drains.

The river channel is very wide and shallow and is distinctly sandy. Previous to the construction of the Elephant Butte dam there were occasional torrential floods, carrying large quantities of silt, followed by reduced flow and periods of entire cessation of flow. In flood periods, tributary streams carried down quantities of heavy gravel and silt which lodged in the river channel and remained as a more or less permanent obstruction. These conditions brought about frequent shiftings of the channel, as is now witnessed by many old river beds and washes existing throughout the valleys.

The present river bed is usually from 4 to 8 ft. below the surface of the bordering lands. The slope of the ground surface normal to the general river course is quite variable, but always comparatively light. Often the land slopes away from the river bank, and in a few places the river bed is slightly elevated above portions of the valley lands. Frequently the lands near the foot of the bluffs are lowest, while in other instances the land surface has a distinct slope toward the river over areas of considerable extent.

The soil is sedimentary and shows great variation in character. Clays, fine

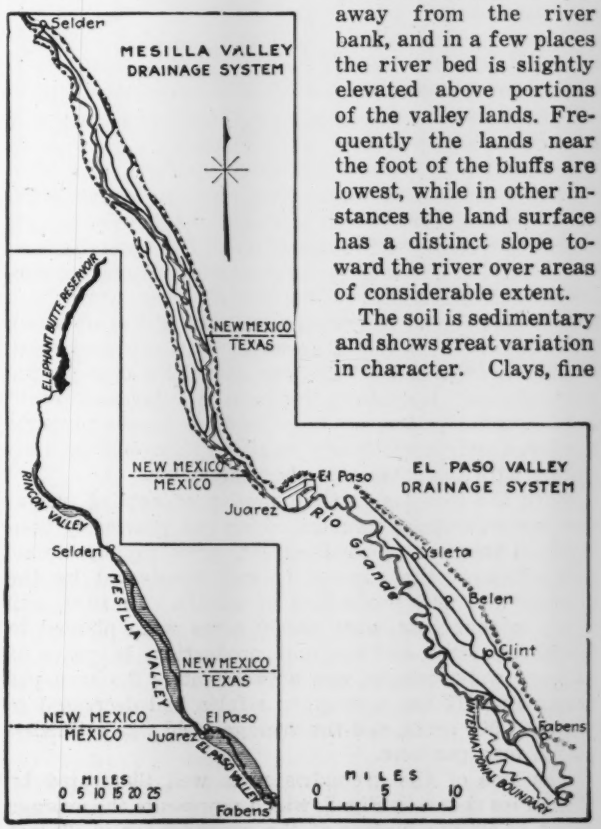


FIG. 1. IRRIGATED AREAS OF RIO GRANDE PROJECT, WITH MAIN DRAINAGE SYSTEMS FOR TWO OF THE THREE VALLEYS

sands and silts are the chief soil-forming elements, and these materials exist without uniformity in pockets and spots of small extent as laid down by flood waters. A distinct uniformity is noted in that sand, grading from "medium fine" to "quicksand," is encountered practically everywhere from 6 to 10 ft. below the surface.

Irrigation farming as practiced by native Spanish and Mexican inhabitants dates back over 300 years in portions of the project. Irrigation works were built and operated under the community system of control by these people until recent years. This early irrigation was dependent wholly upon natural river flow, and the available water was inadequate for the total valley area and frequently insufficient for any irrigation after July.

With the advent of American farmers, ditch systems were improved, and many small pumping plants were installed to supply late-season irrigation. These pumping plants drew their supply from the groundwater, and wells were usually from 40 to 60 ft. in depth, extending to the coarser sands and gravels.

The Elephant Butte reservoir construction began in 1912, and the first storage water was available during the irrigation season of 1915. The Reclamation Service had also constructed several diversion dams and the necessary main feeder canals prior to 1915. The various community ditches remained as part of the permanent irrigation system and were fed by the main Government-constructed canals. The increased water-supply resulted in no immediate increase in the area irrigated, but there was an immediate and considerable increase in the quantity of water applied to the land, and it is probable that water losses from the new canals were high for a period before the channels became silted.

Another result of the operation of the reservoir was the clarifying of the irrigation water which had formerly carried much silt. The use of clear water was responsible for an increase in the rate of loss of water by percolation, as the clear water was absorbed more readily by the soil. This was especially true in the case of field irrigation, because the farmers could not immediately prepare their lands to handle properly the large irrigation "heads" necessary for efficient irrigation with the comparatively clear water.

With the increase in the quantity of applied irrigation water, seepage troubles, which had previously been confined to areas of small extent, grew rapidly worse. The effect of the seepage is well illustrated by the acreage and unit production of alfalfa. In 1914, and prior to that year, over 40,000 acres were planted to alfalfa, and the average unit production, in years of average water-supply, was approximately 3.5 tons per acre. In 1917 the acreage in alfalfa had decreased to about 27,000 acres, and the average yield was estimated at 2.5 tons per acre.

The rise of the groundwater is well illustrated by the curves shown in Fig. 2, which represents the average depth below the surface of the groundwater in 20 test wells in the El Paso Valley. These curves also show the effect of the drains on the water-table. Two drains are now under construction in the area represented, and the maximum effect of the drains will not be apparent until later measurements are made.

Naturally, seepage first affected the deeper rooted crops such as alfalfa, but with the concentration of the alkali salts and the further rise of the groundwater, the shallow rooted crops were also damaged. In places the alkali incrustations resembled a light fall of snow. Large areas became incapable of profitable cultivation. Lower lying areas and river washes filled with stagnant water. Rushes and alkali weeds grew prolifically on fallow fields and along roadsides. The water of the shallow domestic wells became unpotable. Mosquitoes and flies increased, and the sanitation of the entire countryside became impaired. Highway maintenance was difficult; country roads were often impassable.

The extent of the damage is indicated by Table I of seeped areas, based on a survey of the groundwater table.

It was apparent that the alkali and waterlogging were rapidly spreading. If they remained unchecked, increasing areas would succumb to the menace, until sufficient land became swamped to provide drainage through surface evaporation for the remaining cultivated area. Reclamation difficulties increased with each succeeding year. Indeed, without drainage, the loss of the irrigation investment was imminent, as a majority of the farmers would have been forced to abandon their farms.

TABLE I. SEEPED AREAS, JUNE, 1917

Unit	Gross Area	Depth to ground water below surface: On Surface Area	On Surface Per Cent.	0 to 2 Ft. Area	0 to 2 Ft. Per Cent.	2 to 4 Ft. Area	2 to 4 Ft. Per Cent.	Total Less than 4 Ft. Area	Total Less than 4 Ft. Per Cent.	Total More than 4 Ft. Area	Total More than 4 Ft. Per Cent.
Mesilla Valley	88,685	3,800	4.3	16,093	18.1	38,821	43.8	58,714	66.2	29,971	33.8
El Paso Valley	45,096	2,045	4.5	8,802	19.5	20,251	45.0	31,098	69.0	13,998	31.0

Drainage investigations were undertaken in order to find a remedy for this situation. Excellent topographical maps on a scale of 500 ft. to 1 in. with contour interval of 2 ft., already existed. Permanent test wells were installed in sections approximately normal to the river channel. The interval between test-well sections was usually one-half mile, but in some localities it was one mile. The interval between the individual test wells on each section was approximately one-quarter mile. These test wells were installed beginning in 1915, and groundwater measurements were thenceforth taken at bimonthly periods, so that there existed in 1917 considerable data on the movement and progressive rise of the groundwater.

The groundwater measurements taken in June, 1917, which represented average irrigation season conditions, were utilized in connection with the existing topographic maps to prepare drainage base maps. Water contours were developed at 2-ft. intervals from the plotted groundwater elevations, and from the intersection of water contours with those of the ground surface, the areas having groundwater on the surface, from 0 to 2 ft. below the surface, from 2 to 4 ft. below the surface and over 4 ft. below the surface, were marked out on the map. The seeped areas as thus defined were shown in color, so that the worst seeped areas would show strikingly. The acreages shown in Table I were determined by planimetering these areas.

These base maps, together with the plotted sections and boring logs of the permanent test wells, furnished the medium for studying the conditions affecting the

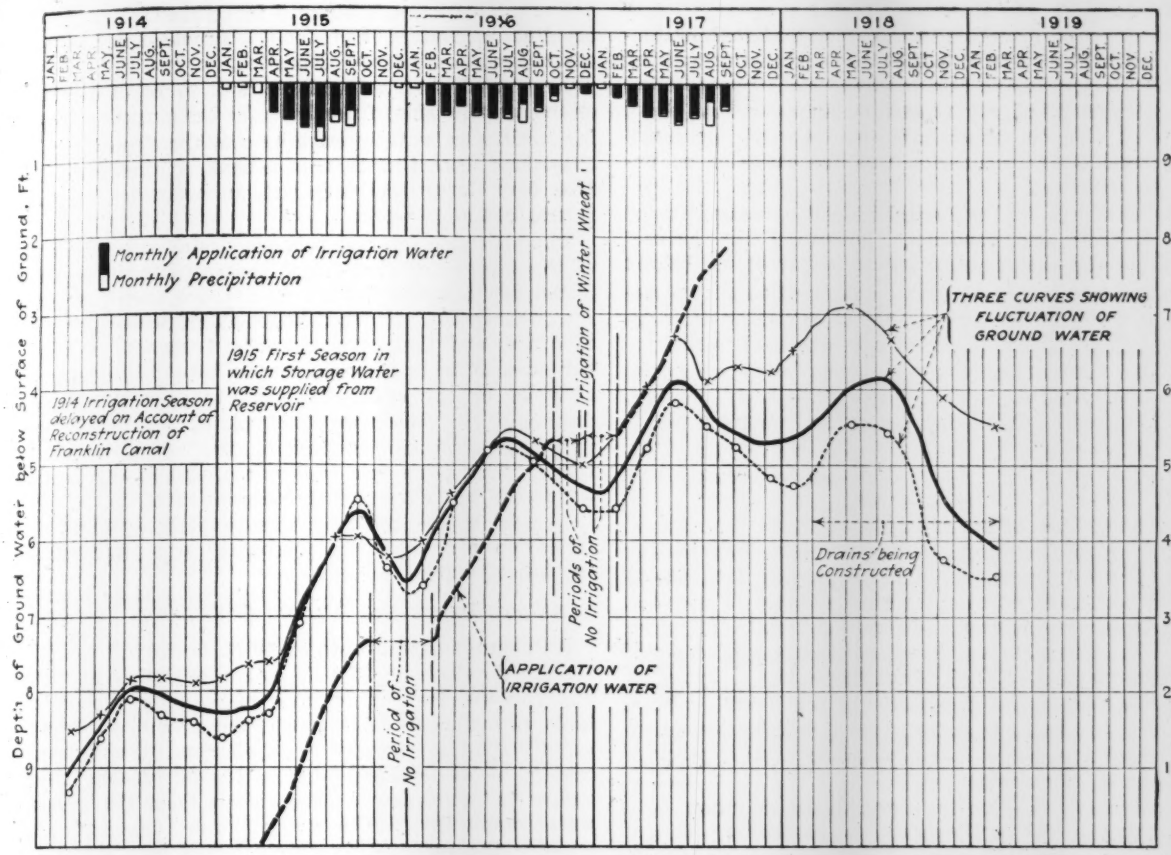

1914
1915
1916
1917
1918
1919
Depth of Ground Water below Surface of Ground, Ft.
Total Depth of Irrigation Water Applied over Gross Area, Ft.
Monthly Application of Irrigation Water
Monthly Precipitation
1914 Irrigation Season delayed on Account of Reconstruction of Franklin Canal
1915 First Season in which Storage Water was supplied from Reservoir
Irrigation of Winter Wheat
Periods of No Irrigation
Period of No Irrigation
APPLICATION OF IRRIGATION WATER
THREE CURVES SHOWING FLUCTUATION OF GROUND WATER
Drains being Constructed

FIG. 2. FLUCTUATION OF GROUNDWATER AND APPLICATION OF IRRIGATION WATER ON RIO GRANDE PROJECT

The total area studied was 8500 acres, of which 5300 acres, net, were irrigated to an average seasonal depth of 4.3 feet, which would cover the 8500 acres to a depth of 2.7 feet. Of the three groundwater curves, the middle one (heavy plain line) is a composite or average of depth readings in 20 representative wells, scattered over the area; the light line with circles shows the average readings in 13 representative wells between Belen and Clint, Tex., and the line with Xs shows the average depth in seven representative wells at Ysleta, Tex. (See El Paso Valley sketch map in Fig. 1.)

planning of a drainage system. Other data considered were the records of water application on the land, the loss of water from canals by percolation, evaporation from free water and from seeped area, the methods of irrigation and the preparation of land for irrigation, and the probable structural formations of the valleys influencing the natural drainage.

The principal causes of seepage appeared to be as follows: (1) The water lost by percolation through all irrigation use; (2) the probable lack of any inconsiderable natural drainage; (3) the water lost from the river bed; (4) the low elevation of certain lands in respect to the position of water surface in the river.

The combined water losses through irrigation must be regarded as the primary cause of seepage. When storage water became available, many localities diverted as much as 8 acre-ft. of water for irrigation. This low duty was in part due to the fact that no control existed over water deliveries, and no direct measurements were made of the quantities delivered to the farms. Another cause for the low duty is found in the clarified storage water previously referred to. Larger farm litches were necessary and lands had to be prepared for shorter irrigation runs, in order to use clear water efficiently. As the water deliveries were supervised by the various communities themselves, no rearrangement of the existing system could be accomplished without first educating the individual farmer in the new problem. Much headway has been made in the educational program, but the reconstruction work will necessarily occupy a considerable period of time. However, such work is now under way in many parts of the project.

The natural drainage, considering the entire valley a unit, was concluded to be *nil*, as the valleys are regarded as closed basins without subterranean outlets other than through the rather tight material of the valley subsoil. The limited cross-section of the valley outlets, especially in the case of the Mesilla Valley, where Prof. Charles S. Slichter determined the subsurface outflow to be only about 6½ miner's inches in 1904, seemed to preclude the deep movement of any large quantities of water.

Conclusions as to the probabilities of loss of water from the river were reached from a study of the position of the groundwater contours, as developed on the base maps. In certain localities the tendency of water movement is outward from the river, while in other places the tendency of flow is inward from the land. Where the tendency of flow is outward on the lower side of sharp bends, it is thought that considerable river loss may take place, and that this flow of water outward and downward under the land may cause a serious accretion to the seepage condition.

Certain restricted areas have such low elevation compared with water surface in the river that their waterlogging was inevitable either as a direct result of river losses or, in the case of areas more remote from the river, from irrigation losses on higher lands. Some tracts of this character had been overwet for many years, and their reclamation was the cause of no immediate concern.

The drainage studies brought about a recognition of certain facts and conditions governing the general design of the drainage system, as briefly stated below:

1. The necessity for greater conservation in the use of water and the impracticability of providing drainage works designed on the basis of present use of water.

2. The flat surface slopes and the low river banks made essential as few drainage outlets as possible, with long drains paralleling the general river course.

3. The drains must cut below the bed of the river, and outlet drains will be partially ineffective at their lower ends while developing grade.

4. The position of drains in respect to the river should depend upon the apparent necessity of intercepting water losses from the river. In some localities, drains should be located as near the river channel as possible, considering maintenance difficulties, while in other places the desirable location is at distances of one-half to three-quarters of a mile from the bank.

5. Flat slopes and the necessity for handling large quantities of drainage water, coupled with known quicksand conditions which exist at grade depths, preclude the use of tile drains.

Location studies looking toward the adoption of a tentative plan for drainage and for estimating its cost were made on the base maps. These maps, as previously described, represented a compilation of all pertinent physical conditions and data governing the problem. They showed the seepage conditions, the land ownership, the ditches, roads and improvements, as well as the surface topography and the direction of groundwater flow.

Cost and Efficiency Estimates Made

Various drainage lines and systems were located on these maps and compared as to cost and probable efficiency, and thus by elimination the best locations were finally determined and a tentative system was adopted for the unit under consideration. The system adopted is termed the "tentative plan" because it is subject to change by reason of the information made available with the progress of work. Experience has shown that it is impossible either to correctly estimate the effectiveness of drains or to anticipate fully all the difficulties of construction in advance of actual work in any given locality. The desirability of having a flexible program is therefore obvious and is, indeed, essential for securing the best results.

The tentative drainage plan adopted for the Rio Grande project provided for the construction of 316 miles of open drains to serve approximately 175,000 acres in the Mesilla, El Paso and Rincon Valleys. The drains were designed with a minimum base width of 6 ft. and a maximum base width of 30 ft. The average depth of cutting was approximately 10 ft., except as the outlet drains approached the river, where grades were gradually raised to meet the river bed. Side slopes were 1½ to 1. The base width was afterward increased to 10 ft. because slopes would not stand.

The excavation was planned to be accomplished with dragline excavators, and designs provided for all excavated material to be deposited on one side of the ditch, except that a low levee was to be constructed on the opposite side of the drain for the purpose of keeping surface water from washing over the slopes. It was considered essential that one bank of the drain be free from large spoil deposits, in order to facilitate future cleaning work.

The allowable interval between drains was estimated on the assumption that drains excavated to the contemplated depth would develop an average accretion from the groundwater of about 1 sec.-ft. of water per mile of drain, and that approximately 1 acre-ft. of water per acre of irrigable area would have to be removed annually by the drains in order to provide adequate drainage. It was thus contemplated that reasonable improvement would be made in the use of irrigation water. This point was emphasized, and it was pointed out to the water users that drainage could not be fully successful unless the land was properly prepared for irrigation and the utmost economy was practiced in the use of water.

Ten-Foot Depth for Drains Considered Essential

An average grade depth of 10 ft. is deemed essential for the development of this estimated inflow of water and for the further purpose of keeping the water-table at sufficient depth below the ground surface to prevent the rise of water by capillarity. The high percentage of white alkali salts in the soil renders it necessary to stop surface evaporation from the groundwater supply in order to accomplish drainage and make possible the reclamation of alkalied areas. Local silt soils have great capillarity and from 4 to 6 ft. of unsaturated soil is necessary for diversified farming.

On the above basis, it was expected that drains would be effective from distances of from one-half to three-quarters of a mile, and locations were made on this assumption, and taking into consideration other local conditions, such as the shape of the particular area under consideration and the probable direction of groundwater movements. Surface irregularities also influenced locations, and it is expected that the river-side intercepting drains will drain a less area than other drains because they have the river on one side.

The results accomplished by constructed drains are quite encouraging. The test-well measurements indicate a consistent slope of the groundwater toward the drains of approximately 1 ft. to 1000 ft. under average irrigation-season conditions. A loss of head of about 1.5 ft. occurs very close to the drain section, as determined by numerous measurements. This loss of head seems somewhat comparable to an entrance head loss, and must be considered in estimating the effectiveness of drains and in planning their necessary depth.

The drainage discharge from groundwater development ranges from an approximate average of 1.17 cu. ft. per second per mile of drain during the nonirrigation season to an approximate average of 1.75 cu. ft. per second per mile of drain during the irrigation season. Basing a conclusion on the irrigated area tributary to the drains, this discharge corresponds to a development of 0.0019 sec.-ft. per acre for the nonirrigation season and 0.003 sec.-ft. per acre for the irrigation season.

The groundwater measurements indicate that drains

accomplish a lowering of the groundwater at a maximum normal distance of three-quarters of a mile. At one-half mile the lowering is usually marked and probably is sufficient to accomplish efficient drainage. The maximum benefit will not be felt in any particular unit until all drains proposed for construction are completed. In this connection it should be stated that the real test of the sufficiency of the drainage system will come only after all the described area is brought under irrigation.

It is noted that the drains are quickly effective, and it is estimated that some 30,000 acres have been fully drained by the works already constructed, while an additional area has been protected against the spread of seepage. Old alfalfa plants seem especially responsive to drainage, and their shallowed roots penetrate downward almost immediately after a lowering of the groundwater has been effected. All crops are noticeably healthier in the portions of the project now drained. The relief afforded by the drains now built indicates that the valleys will be fully reclaimed and that the drained lands will then have great and lasting fertility.

It was decided to accomplish the proposed work by Government forces, in order to permit more flexibility as regards necessary changes in plans. It was also thought that a saving in cost could be made under this method, as the Reclamation Service had at its disposal forces trained in this kind of work.

The poor quality of boiler water obtainable and the absence of sufficient electric power led to the choice of draglines driven by internal-combustion engines as the principal equipment for the work. Four machines of this type were received on the project in July, 1917. They were 1½-cu. yd. draglines with 50-ft. booms and were mounted on caterpillar traction. Each machine weighed approximately 55 tons. Power was provided

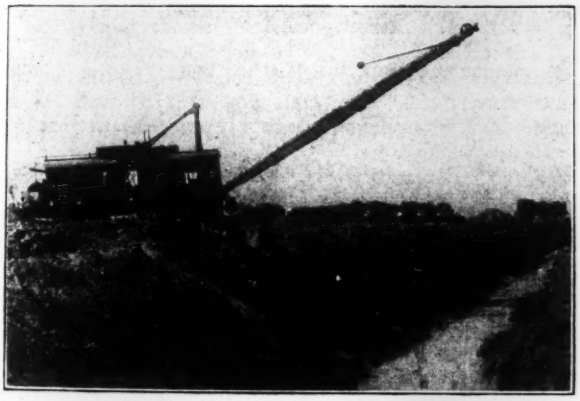


FIG. 3. RECUTTING DRAINAGE DITCH WITH DRAGLINE EXCAVATOR TO PROPER GRADE DEPTH

by 6-cylinder, 98-hp. kerosene-burning engines. Distillate was later substituted for kerosene because of lubrication difficulties caused by kerosene, and this fuel proved to be more efficient under the extremely variable load conditions.

Early experience with these machines, which were the first constructed of this specific type, showed the advisability of providing more powerful engines and of making other improvements necessary to develop a high-speed machine capable of continuous three-shift operation. The manufacturers coöperated in this development, which resulted in minor changes in design and a change in engines to 125-hp., 4-cylinder distillate-burning type. The changes were made in the field in August and September, 1918, and four new machines were also furnished in accordance with the new specifications and installed on the project in October and November, 1918.

The fleet of draglines now employed on the work consists of eight caterpillar-traction machines, as described above; two smaller machines equipped with 40-ft. booms, 1-cu.yd. buckets and walking traction; one 60-ft. boom, 2-cu.yd. walking traction machine and one 40-ft. boom, 1-yd. steam machine. The above equipment is owned and operated by the Reclamation Service. One contractor is also employed on the work, operating a land-dredge type of machine which spans the cut. This machine is equipped with a 60-ft. boom and a ¾-cu.yd. bucket.

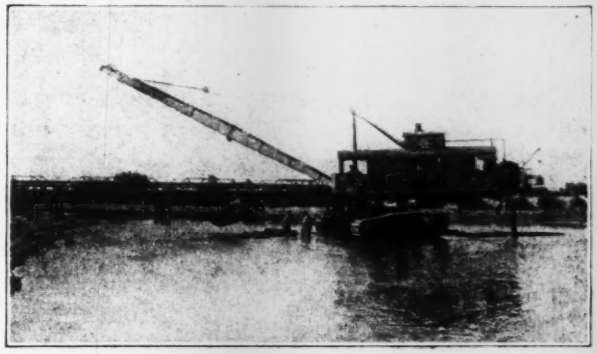


FIG. 4. DRAGLINE EXCAVATOR LAYING ITS OWN TRACK-WAY ACROSS RIO GRANDE AT FABENS, TEXAS

The track-way is composed of timbers held together by wire cable so they may be picked up and lowered, as shown. The same general plan was used in moving the machine across soft ground

Dragline crews consist of one engineman and one laborer, in addition to the operator. Each machine is in charge of a chief operator who operates the day shift and is responsible for the upkeep of machinery and the general output of the machine. The mechanical features are in charge of the master mechanic, who also supervises the machine shop which is maintained to facilitate repair work. All machines are operated in three 8-hour shifts per day, and general repair and cleaning-up work is accomplished by the chief operator and crew on Sunday.

Careful records are kept of the machine's time and the excavation accomplished by each shift. Standard report forms are provided, and daily reports are required from each operator. These reports form the basis of monthly efficiency reports which are prepared for the purpose of comparing the results accomplished by the various machines and by the individual operators. (See Table II.)

A comparative system of grading is used to show the standing of each operator for the month and also "to date." Grades are based on "cost" and "excavation per shift," equally weighed, and compared with the average results produced by the total number of operators working under comparable conditions. Grades indicate whether they are below or above average by being over or under 100%. These efficiency reports are posted monthly on each machine and in each field camp, and an attempt is made to recognize properly

TABLE II. SUMMARY OF OPERATION COST AND EFFICIENCY OF EIGHT CATERPILLAR DRAGLINE EXCAVATORS, WITH 50-FT. BOOM AND 1½-CU.YD. BUCKET

To Dec. 31, 1918

Machine Number	Period: Began Excavation	Period: Began Changing Engines	Excavation: Months Operating	Excavation: Linear Feet	Excavation: Miles	Excavation: Cubic Yards	Cost Distribution: Labor, Machine and Ground Crews, Total	Labor, Machine and Ground Crews, Per Cu.Yd.	Miscellaneous Labor and Minor Expense, Total	Miscellaneous Labor and Minor Expense, Per Cu.Yd.	Fuel, Total	Fuel, Per Cu.Yd.
4 Old Machines with Twin City Engines, 93 Hp.												
3	July 25, '17	Aug. 11, '18	12.5	51,446	9.75	413,479	$8,990.39	$0.021	$385.68	$0.001	$6,205.13	$0.015
4	July 24, '17	Aug. 4, '18	12.3	39,320	7.45	331,199	9,404.30	.028	314.34	.001	6,245.83	.0126
5	Aug. 25, '17	Aug. 28, '18	12.1	43,065	8.15	344,528	7,815.48	.023	982.58	.003	5,315.13	.016
6	Aug. 24, '17	Sept. 14, '18	12.6	56,950	10.80	378,216	8,606.32	.023	638.56	.0017	5,567.43	.015
4 old machines Twin city engines			49.5	190,780	36.20	1,467,422	34,816.49	.024	2,321.16	.0016	23,333.58	.016
4 Old Machines with Atlas Engines, 125 Hp.												
3	Sept. 5, '18		3.8	14,185	2.8	130,217	3,291.80	.025	71.54	.00054	2,824.99	.022
4	Aug. 25, '18		4.2	14,875	2.8	142,654	3,505.67	.025	159.56	.001	2,654.85	.0186
5	Oct. 1, '18		3.0	13,365	2.5	134,993	2,283.87	.017	467.60	.0034	1,681.61	.012
6	Oct. 19, '18		2.3	9,930	1.9	87,554	2,760.47	.035	90.43	.....	1,242.16	.0141
	4 old machines Atlas engines		13.3	52,985	10.0	495,418	11,841.81	.024	789.13	.0016	8,403.61	.017
4 old machines to date			62.8	243,765	46.20	1,962,840	46,658.30	.0237	3,110.29	.0016	31,737.19	.016
4 New Machines with Atlas Engines, 125 Hp.												
7	Sept. 13, '18		3.5	13,010	2.5	94,142	2,112.00	.022	110.58	.001	1,408.17	.015
8	Oct. 4, '18		2.9	17,080	3.2	170,542	2,347.47	.014	390.80	.002	17,984.49	.011
9	Oct. 29, '18		2.1	10,770	2.0	105,113	1,712.56	.016	112.70	.001	1,358.98	.013
10	Nov. 4, '18		1.9	11,200	2.1	19,313	1,215.30	.015	201.93	.003	1,193.40	.015
	4 new machines Atlas engines		10.4	52,060	9.8	449,110	7,387.33	.016	816.01	.0018	5,759.04	.013
8 Machines with Atlas Engines												
8 machines with Atlas engines			23.7	105,045	19.8	944,528	19,229.14	.020	1,605.14	.0017	14,162.65	.015
8 Bucyrus Machines to Date												
8 machines to date			73.2	295,825	56.0	2,411,950	54,045.63	.022	3,926.30	.0016	37,496.23	.015

Cost Distribution

Machine Number	Hauling Fuel, Total	Hauling Fuel, Per Cu.Yd.	Water, Total	Water, Per Cu.Yd.	Wire Rope, Total	Wire Rope, Per Cu.Yd.	Lubricants, Total	Lubricants, Per Cu.Yd.	Minor E. R. & S., Total	Minor E. R. & S., Per Cu.Yd.	Total	Per Cu.Yd.
4 Old Machines with Twin City Engines,												
3	$526.29	$0.001	$4.24	.....	$792.20	$0.002	$2,192.05	$0.005	$5,086.09	$0.012	$1,338.71	$0.003
4	598.67	.00066	6.67	.....	770.11	.002	2,346.96	.007	6,352.56	.0126	1,198.92	.0027
5	1,108.83	.003	9.15	.....	834.77	.002	1,855.82	.0054	4,635.06	.014	1,188.22	.003
6	600.80	.002	6.59	.....	508.00	.002	1,941.09	.0051	5,071.50	.013	1,274.90	.003
4 old machines, Twin City engines	2,834.59	.0019	26.65	.....	2,905.08	.00199	8335.92	.0057	2,145.21	.0144	5,000.75	.0034
4 Old Machines with Atlas Engines, 125 Hp.												
3	197.80	.002	.....	.....	690.40	.005	592.50	.005	1,143.58	.0087	593.34	.0045
4	210.39	.001	.....	.....	308.20	.002	563.25	.0039	1,267.25	.0088	548.25	.0038
5	249.39	.0018	26.12	.....	204.75	.0015	264.30	.0019	1,085.54	.0080	404.88	.0029
6	302.64	.0034	108.22	.0012	366.22	.0042	479.74	.0054	1,193.00	.0136	304.11	.0034
4 old machines, Atlas engines	960.22	.002	134.34	.0003	1,569.57	.003	1,899.79	.004	4,689.37	.009	1,850.58	.0037
4 old machines to date	3,794.81	.0019	160.99	.....	4,474.65	.0023	10,235.71	.005	21,834.58	.011	6,851.33	.0035
4 New Machines with Atlas Engines, 125 Hp.												
7	125.90	.001	.....	.....	175.00	.002	424.10	.005	452.44	.005	568.37	.006
8	329.52	.002	52.50	.....	342.26	.002	383.01	.002	1,493.52	.009	511.63	.003
9	111.19	.001	45.93	.....	156.27	.002	242.64	.002	930.65	.009	320.99	.003
10	77.80	.001	.....	.....	199.00	.003	182.45	.002	160.00	.002	569.86	.007
4 new machines, Atlas engines	644.31	.001	98.43	.....	872.53	.002	1,232.20	.0027	3,036.61	.0067	1,970.85	.0039
8 Machines with Atlas Engines												
8 machines with Atlas engines	1,604.63	.0017	232.77	.0002	2,442.10	.0026	3,131.99	.0033	7,725.98	.008	3,821.43	.0038
8 Bucyrus Machines to Date												
8 machines to date	4,439.12	.0018	259.42	.....	5,347.18	.0023	11,467.91	.0045	24,870.69	.0112	8,822.18	.0036

Machine Number	Cost Distribution: Equipment, Total	Equipment, Per Cu.Yd.	Total	Per Cu.Yd.	Time Distribution: Shifts Charged Operation	Operating %	Repairing %	Delays %	Performance: Mi. per Mo.	Lin. Ft. per Shift	Cu. Yd. per Shift	Cost of Operation: Total Cost	Cost per Cu.Yd.	Cost per Foot	Cost per Mile	Cost per Shift	Cost per Month
4 Old Machines with Twin City Engines,																	
3	$11,288.14	$0.028	$37,088.39	$0.090	927.0	45	37	18	0.78	55.5	446	$37,088.39	$0.090	$0.72	$3,805	$40.00	$2,965.00
4	10,281.10	.031	37,520.22	.1132	909.5	45	47	8	0.61	43.3	365	37,520.24	.113	.95	5,036	41.30	3,050.40
5	8,238.85	.024	32,452.25	.095	823.5	51	34	15	0.67	41.9	419	32,452.35	.094	.94	4,980	39.40	2,682.00
6	9,143.56	.024	33,507.30	.0885	932.0	52	34	14	0.86	40.6	406	33,507.50	.089	.59	3,100	36.00	2,670.00
4 old machines, Twin City engines	38,951.65	.0265	140,568.16	.0958	3,592.0	49	38	13	0.73	53.1	409	140,491.04	.096	.74	3,882	39.20	2,838.00
4 Old Machines with Atlas Engines, 125 Hp.																	
3	2,338.20	.018	11,744.15	.090	298.5	55	23	22	0.74	49.6	436	11,744.15	.090	.83	4,195	39.30	3,090.00
4	2,399.63	.0168	11,707.66	.082	298.0	64	22	14	0.66	50.0	479	11,707.64	.082	.79	4,190	39.40	2,790.00
5	1,538.66	.0113	8,425.09	.0624	225.0	64	16	20	0.83	59.4	600	8,425.09	.060	.63	3,368	37.40	2,809.00
6	1,288.50	.0147	6,545.91	.0747	198.5	58	19	13	0.83	50.0	441	6,545.71	.075	.66	3,445	33.00	2,845.00
4 old machines, Atlas engines	7,564.99	.015	38,422.81	.07756	1,020.0	60	22	18	0.75	51.9	486	38,499.93	.078	.73	3,850	37.75	2,894.00
4 old machines to date	46,516.64	.023	178,990.97	.0911	4,612.0	51	..	14	0.73	52.9	426	178,990.97	.091	.73	3,890	38.80	2,869.00
4 New Machines with Atlas Engines, 125 Hp.																	
7	1,743.27	.018	7,326.93	.078	169.0	62	17	21	0.71	77.0	556	7,326.93	.078	.56	2,932	43.35	2,093.00
8	3,410.84	.020	11,060.04	.065	229.0	67	15	18	1.10	74.6	744	11,060.04	.065	.65	3,457	48.40	3,812.00
9	2,140.26	.020	7,138.02	.068	161.0	63	25	12	0.95	66.9	653	7,138.02	.068	.66	3,400	44.30	3,398.00
10	1,596.80	.020	5,396.54	.068	108.0	62	19	19	1.10	103.7	480	5,396.54	.068	.48	2,568	50.00	2,839.00
4 new machines, Atlas engines	8,891.17	.0198	30,921.53	.069	679.0	64	19	17	0.94	76.7	661	30,921.53	.069	.59	3,106	45.55	2,975.00
8 Machines with Atlas Engines																	
8 machines with Atlas engines	16,456.16	.0174	69,344.34	.0732	1,699.0	62	21	17	0.83	61.8	555	69,421.46	.0735	.66	3,506	40.85	2,930.00
8 Bucyrus Machines to Date																	
8 machines to date	55,407.81	.0219	209,912.50	.087	5,291.0	53	33	14	0.77	55.9	456	209,912.50	.087	.71	3,750	39.70	2,865.00

Machine Number		Fuel Consumption: Ave. Cost per Gal.	Fuel Consumption: Amount Used (Gal.) Total this Yr.	Fuel Consumption: Amount Used (Gal.) Per Shift	Yards per Gal.	Cost per Yard	Gasoline: Ave. Cost per Gal.	Gasoline: Amount Used (Gal.) Total this Yr.	Gasoline: Amount Used (Gal.) Per Shift	Cost per Yd. for T. Exc.	Lubricating Oil: Ave. Cost per Gal	Lubricating Oil: Amount Used (Gal.) Total this Yr	Lubricating Oil: Amount Used (Gal.) Per Shift	Lubricating Oil: Cost Per Yd.
4 Old Machines with Twin City Engines														
3	Kerosene	$0.13	8,425	46.8	7.1	$0.0183	$0.25	637	3.5		$0.61	640	3.6	
	Distillate	.144	16,290	38.4	13.9	.0103	.25	2,237	5.3		.61	2,189	5.2	
4	Kerosene	.13	7,390	44.0	7.2	.0182	.25	1,723	10.3		.61	510	3.0	
	Distillate	.144	14,675	32.6	10.5	.0137	.25	1,963	4.4		.61	2,078	4.6	
5	Kerosene	.13	5,238	33.8	7.5	.0174	.25	996	6.4		.61	409	2.6	
	Distillate	.141	19,945	43.7	13.1	.0108	.25	2,089	4.6		.61	2,439	5.3	
6	Kerosene	.13	4,806	37.5	7.9	.0164	.25	683	5.3		.61	307	2.4	
	Distillate	.141	20,114	36.9	11.5	.0122	.25	2,318	4.2		.61	2,243	4.1	
4 old machines Twin City engines	Kerosene	.13	25,859	41.0	7.3	.0177	.25	4,039	6.4	0.00.9	.61	1,866	3.0	0.0045
	Distillate	.143	70,964	37.9	12.3	.0116	.25	8,607	4.6	.0028	.61	8,949	4.8	0.0072
4 Old Machines with Atlas Engines, 125 Hp.														
3	Distillate	$0.16	12,595	42.2	10.3	.0155	.25	2,150	7.3		.62	825	2.8	
4	Distillate	.16	12,610	42.3	11.3	.0141	.25	2,057	6.9		.62	898	3.0	
5	Distillate	.153	10,092	44.8	13.4	.0114	.25	640	2.8		.62	538	2.4	
6	Distillate	.153	6,995	35.2	12.5	.0122	.25	538	2.7		.62	641	3.2	
4 old machines, Atlas engines	Distillate	.156	42,292	41.5	11.7	.0133	.25	5,386	5.3	.0037	.62	2,902	2.8	.0036
4 old machines, to date	Distillate only	.15	113,256	39.1	12.0	.0125	.....	13,993	4.8	.0028	....	11,851	4.1	.006
4 New Machines with Atlas Engines, 125 Hp.														
7	Distillate	.163	6,765	40.0	13.9	.0117	.25	1,090	6.5		.62	660	3.9	
8	Distillate	.154	12,069	52.7	14.1	.0109	.25	1,021	4.5		.62	597	2.6	
9	Distillate	.154	8,504	52.8	12.4	.0125	.25	638	4.0		.62	159	1.0	
10	Distillate	.163	5,830	53.9	13.6	.0120	.25	990	9.1		.62	275	2.5	
4 new machines, Atlas engines	Distillate	.159	33,168	48.8	13.5	.0117	.25	3,739	5.5	.0021	.62	1,691	2.5	.003
8 Machines with Atlas Engines														
8 machines with Atlas engines	Distillate	.157	75,460	45.2	12.5	.0121	.25	9,125	5.4	.0024	.62	4,593	2.7	.003
8 Bucyrus Machines to Date														
8 machines to date	Distillate	.153	146,424	41.0	12.4	.0123	.25	17,732	5.0	.0027	.618	13,542	3.8	.0052

each meritorious record. In this manner a friendly rivalry is stimulated and the daily work becomes somewhat of a game, with keen interest centered on monthly results. Direct benefit accrues to both the individual and to the job, as mediocre operators frequently perfect themselves under the spur of ambition, while the hopelessly poor material may be readily spotted and removed from the work.

The work accomplished to June 1, 1919, consists of the excavation of 5,314,160 cu. yd. in 115 miles of drain. The eight caterpillar draglines are making especially gratifying records. The highest monthly machine's record to date has been 80,000 cu. yd. in 76 shifts, and the highest monthly average for the eight draglines has been 53,500 cu. yd. each in 72 average shifts. Detailed cost records of excavation work to Dec. 31, 1918, are shown in Table II, and the total cost to June 1, 1919, is summarized in Table III.

TABLE III. TOTAL COST OF DRAIN CONSTRUCTION ON THE RIO GRANDE PROJECT, NEW MEXICO–TEXAS, TO JUNE 1, 1919

Drains built by Government forces	112 miles
Drains built by contract	3 miles
Total length of drains	115 miles

Classification	Total Cost	Unit Cost: Per Mile	Unit Cost: Per Cu.Yd.	Per Cent.
Excavation:				
Govt. forces—5,149,500 cu.yd.	$452,816	$4,043.00	$0.087	51.2
Contract 164,760 cu.yd.	17,300	5,766.67	0.105	1.8
Structures—320	205,729	1,788.94	0.038	23.3
Examinations and surveys	63,460	55.18	0.011	7.2
*Right of way	34,312	298.36	0.006	3.9
**Overhead expense	110,850	963.91	0.028	12.6
Totals and averages	$884,467	$7,691.06	$0.166	100.0

* This item includes rebuilding of irrigation laterals.
** Overhead expense includes general expense, engineering, superintendence, and maintenance of field camps.
An equipment depreciation charge of 2c. per cubic yard is included in the excavation costs for Government forces.
Contract cost shown is contract price and not cost to the contractor.

Some changes in plans have been made since construction work started, notably in connection with location. It proved impossible to construct a 6-ft. width of base, because of the flat slope assumed by quicksand at grade depth, and a 10-ft. minimum base width is now used. Frequently it is necessary to reëxcavate the drain in order to maintain grade depth after a period of ten days or two weeks has elapsed and the soil water running into the drains has assumed a flatter slope.

Structure work constitutes about 25% of the cost of building the drains. The cost is materially increased by quicksand conditions which necessitate sheet piling for all foundation work.

Concrete is used for more important structures and timber for the many minor structures. Quantities of 36-in. reinforced-concrete tile are utilized for constructing culverts under canals and surfaced highways. The tile are manufactured in 6-ft. lengths in convenient yards near the work. They are hauled to the crossing site in trucks and placed in position with the draglines. The tile are embedded in sufficient concrete to insure alignment and render the joints tight, and are laid as one-, two- or three-barrel structures, as capacity demands. This type of culvert is cheaper and has the distinct advantage of being more quickly installed than the monolithic box type. This quick-installation feature is important in the case of canal crossings, because crops depend upon practically uninterrupted irrigation service.

The smaller lateral and farm-ditch crossings are made with metal fluming carried on a timber substructure, and the less important bridges, both highway and farm, are built of timber in either one or three spans, supported on piling.

Output of Electric Power Given

According to figures recently compiled by the Division of Power Resources, United States Geological Survey, electric power plants in the United States engaged in public service, including central stations, electric railways, and certain other plants, furnished, in March, a daily average of 101,400,000 kw.-hr. Forty-one per cent was produced by water-power. From figures furnished by those plants using coal, the average consumption per kilowatt-hour was found to be 3 lb. Figures were based on 3075 reports, estimated as coming from 89 per cent of public service plants.

New Data on Ship Stresses

Results of Strainagraph Measurements on Ships at Sea and During Launching—Stress-Distribution Accords With Design Assumptions—Beam Stresses in Cross-Section

EXPERIMENTAL data that will furnish new material for the structural design of ships have been obtained in extensometer measurements made on steel and concrete vessels, both at sea and during launching, by engineers of the Emergency Fleet Corporation. The work was begun for the purpose of giving exact knowledge on which to base the design and the improvement of concrete ships, but it has yielded at least equally important results in its application to steel ships. Its success is due to the reliability of the instrument devised for the measurements, and to the fact that the work was planned and carried out on so large a scale as to permit of using a great many instruments simultaneously and thereby obtaining stress results covering virtually the entire ship at once, in place of single figures applicable to one point only and not comparable with others.

Broadly considered, the results of the work up to the present may be summarized in two conclusions:

1. Concrete steamships as designed and built within the past two years are serviceable and safe from the structural standpoint and have but minor points of weakness that should be readily eliminated in future construction. Their stresses compare fairly with those existing (theoretically and practically) in steel ships.

2. Steel ships act as completely elastic structures in the same sense as a bridge, and are subject to a constant sine-wave reversal of stress. Their principal strength function, longitudinal beam action, is exercised in a manner closely similar to that assumed in current designing practice. The upper decks share somewhat less in the girder-flange action than expected. On account of the great excess of material in the double bottom, the neutral axis of the girder is very low, and the deck stresses are therefore the highest in the ship's structure. Superimposed stress waves amounting (in the deck) to at least 2000 lb. per square inch are set up by flexural vibrations due to pounding in heavy seas.

The Strainagraph for Recording Deformations

To make the work possible, it was necessary to construct a continuously recording extensometer, since rapidly varying strains had to be measured. Prof. F. R. McMillan, research engineer for the Fleet Corporation, worked out the design of the instrument. He succeeded in making a combination of a distance bar or gage bar with the recording element of a recording pressure gage manufactured by the American Steam Gage & Valve Manufacturing Co. for work on air-brake equipment. After some development work (carried out in less than three weeks) 24 "strainagraphs" were built. At the same time 13 water-pressure recorders were built, in order that the hydrostatic head at different points of the submerged hull surface could be measured, as it was desired to have knowledge of the applied moments when studying stress variations, and also to compare the actual pressures with those of the usual standard-wave assumptions. This pressure recorder is a modification of the air-pressure recorder mentioned.

The strainagraph registers the changes in the gage length by drawing a curve on a moving strip of paper. The latter travels from a supply roll over a record cylinder to a rewind roll and is driven by the record cylinder through sprocket teeth which engage holes punched in the edge of the strip. The rewind roll is driven from the record cylinder by friction contact, which gives a slight tension in the paper and at the same time takes up the inequalities of winding speed.

At first the record or driving cylinder was actuated by clockwork, but an electric motor (1/200-hp. motor for 12 to 24 volts) from which a coil-spring belt goes to a small train of gears driving the cylinder is now used. This gives more uniform paper speed and simplifies the simultaneous operation of a large number of instruments. Two pen arms write on the strip as it passes over the record cylinder, one being actuated by clock contact to mark 10-second intervals, while the other is the strain recorder. This latter pen moves with a multiplication of 140 as compared with the movement of the gage bar or distance bar, through two levers in series.

The large lever shown at the bottom of the case in the larger view in Fig. 1 receives the motion of the distance bar through a short plunger bearing against a knife-edge at the circumference of the lever shaft, forming the short arm of the lever. This gives a multiplication of 9; the remainder of the multiplication is secured through the lever ratio of the pen arm, which connects to the long end of the first lever.

The outer end of the contact plunger, in contact with

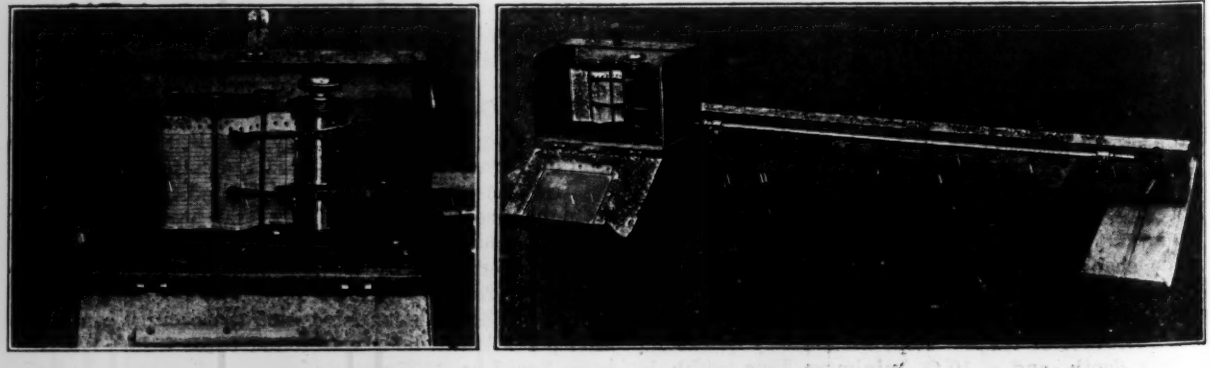


FIG. 1. THE "STRAINAGRAPH" AND ITS RECORDING GAGE BOX

the end of the gage bar, is spherical, which allows for adjustment in setting up the instrument and so avoids binding. In applying the instrument, the far end of the bar and the recording instrument are each clamped to a ¾-in. steel stud fastened to the ship; the methods of fastening the stud differed somewhat according to location.

As usually set up, the instrument produced records whose vertical scale was approximately 5000 lb. per square inch steel stress per inch of height, and whose horizontal scale (paper speed) ranged from 10 to 15 in. per minute.

The actual conduct of the experiments on board ship was in each instance a rather formidable undertaking. This is suggested by the photograph, Fig. 5, showing the assembled test equipment, piled in the hold of the "Atlantus"; besides the 25 strainagraphs and 12 pressuregraphs, the group includes 28 large boxes and switchboards, batteries, motors and pipe connections, and more than two miles of electric conductors. Correspondingly, the physical task of testing is large, and engages a group of observers sufficient to enable all the operating instruments to be kept under supervision simultaneously.

Its Applications

Four important applications of the strainagraph have been made up to the present. The objects of measurement were:

Sea-service stresses in the concrete ship "Faith" on its maiden voyage, San Francisco to Vancouver, May-June, 1918.

Launching stresses in the concrete ship "Atlantus," Brunswick, Ga., Dec. 4, 1918.

Service stresses in the steel ship "Westboro" (8800 tons d.w. capacity) during a transatlantic voyage, February-March, 1919.

Docking stresses in the concrete ship "Atlantus," June 10-11, 1919.

One of the curves obtained on the "Faith," the pioneer concrete steamship, is shown in Fig. 2, where a maximum range of stress corresponding to 7055 lb. per square inch stress in the steel is represented; this is the stress in a longitudinal deck-beam on a line along the port side of the hatches, about midway between hatches 2 and 3.

While the work on the "Faith" was of great value, it did not give a conclusive demonstration of the accuracy and sensitiveness of the strainagraph, but this was found later in tests made during the launching of the "Atlantus." A pair of representative curves from this test is reproduced in Fig. 3. This clearly pictures the rise in hogging stress as the ship moved down the ways and progressively lost stern support; the rapid but not abrupt change from hogging to sagging when the stern lifted off; and the final condition of slight hogging when the ship was afloat. It is noteworthy that the greatest stress recorded exceeded that measured in the "Faith" during a storm. As stated farther on, the "Atlantus" results agreed so closely with calculations as to prove the high accuracy of the strainagraph measurements. They also showed the instrument to be satisfactorily sensitive.

But on this latter point some of the rough-weather records obtained on the steel ship "Westboro" are more significant. That reproduced in Fig. 4 registers an elastic vibration of more than 1-min. duration, set up by the impact of the bow on the water after it had lifted clear.

Launching Test; Accuracy of Instrument

Fig. 5 gives a group of three sets of curves showing the distribution of upper and lower flange stresses in the "Atlantus" at three different periods in its launching, and summarizes most of the results of this experi- Curves derived from these are shown in the smaller diagram in the same figure, giving a comparison of the time-change of stress at Section 27, a little forward of amidships, both as measured and as computed from the drafts recorded by the pressure instruments.

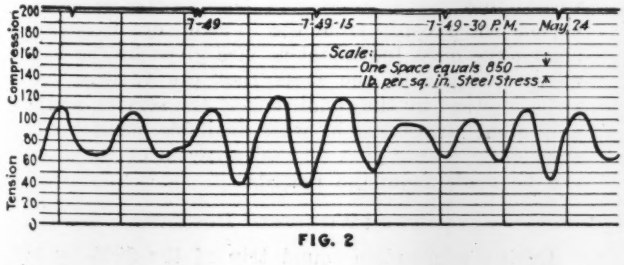


FIG. 2

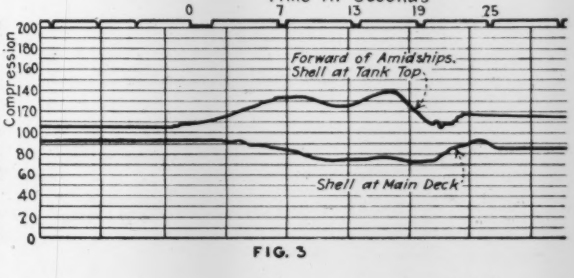


FIG. 3

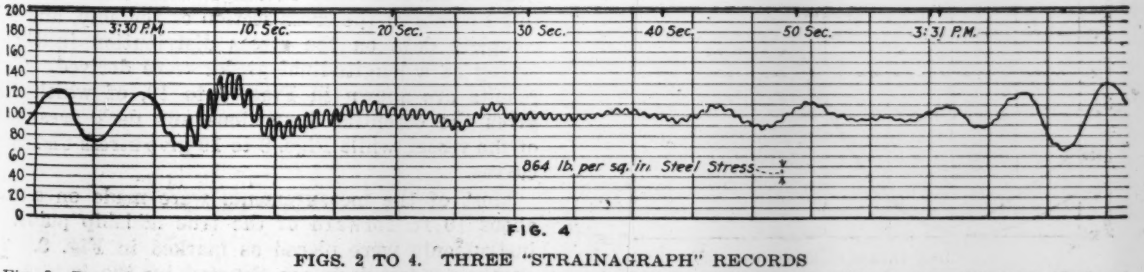


FIG. 4

FIGS. 2 TO 4. THREE "STRAINAGRAPH" RECORDS

Fig. 2—Record from concrete ship "Faith," May 24, 1918; stress in deck beam between hatches in line with port side hatch. Fig. 3—Longitudinal stress in concrete steamer "Atlantus" during launching; two simultaneous curves, made by separate instruments, shown superimposed; maximum stress in shell just above bilge and at main-deck level, about midships; maximum change of stress from high point to low point, about 5000 pounds per square inch steel stress, at extreme fiber. Fig. 4—Pounding record from steel ship "Westboro"; on shell plate one foot below bridge deck; bow of ship striking water, after lifting out, in heavy sea.

FIG. 5. EQUIPMENT FOR "ATLANTUS" TESTS PILED IN HOLD

It will be seen that an astonishingly close agreement prevails, which constitutes a reliable check on the accuracy of the measurements. No indications of inertia effects or lost motion could be detected.

For two other sections some distance forward and aft of this one, the agreement is somewhat less close. However, there are reasons for attributing this to inaccuracy in the computed curves. In the one case there is reason for believing that some error is involved in the assumptions concerning buoyancy. In the other case, uncertainty as to the distribution of cradle reaction affects the computations.

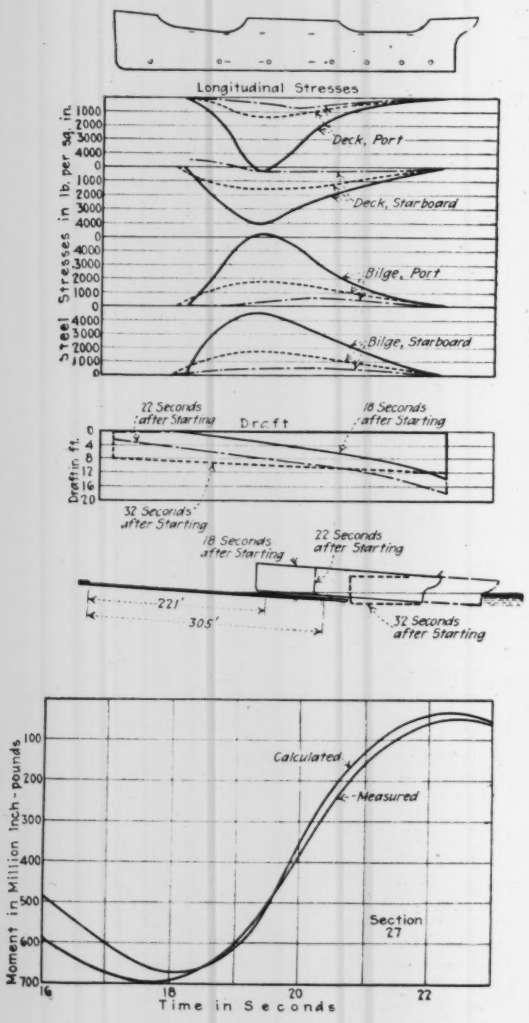


FIG. 6. LONGITUDINAL STRESSES IN "ATLANTUS" DURING LAUNCHING; ACCURACY OF MEASUREMENT SHOWN BY COMPARISON WITH CALCULATION

A valuable sidelight on the stress-measurement work was given by the occurrence of the first hump in the launching curve shown in Fig. 3, representing an abnormally high hogging stress. The groundways, it was found, departed 1½ in. from true profile at one point, and the passage of the cradles over this rise produced a tension of 4600 lb. per square inch in the deck steel at section 27. This stress was nearly as high as the maximum, which occurred a short time later just over the end of the ways, and both exceeded the greatest stresses observed in the "Faith" at the height of a heavy storm. Since even greater stresses might be produced by such irregularities in the ways, it is clear that scrupulous care must be taken in the preparations for launching a concrete ship endwise, in order to avoid abnormal stresses, a fact not previously appreciated.

STRESSES IN THE "FAITH"

With this evidence of the reliability and sensitiveness of the instruments at hand, the deductions from the measurements made on the "Faith" acquire special interest. They are stated as follows by Mr. McMillan: Even in a severe storm the maximum stresses in the critical sections showed margins of safety well exceeding those anticipated in the design. To those who were aboard the "Faith" it was most reassuring to note that as the storm developed, and steadily increased to unusual severity, the strainagraph records showed a constant increase in stress, yet with a very comfortable margin at all times. It is believed that without the knowledge supplied by the strainagraph a high degree of uncertainty would have been felt, and justifiably so, by those aboard who were competent to estimate the hazards of heavy weather at sea in the first concrete vessel of seagoing character. For the time at which they were taken and the necessities of that period, the records from the "Faith" are regarded as among the most important service given by the instrument, in spite of the facts that the various limitations imposed by the conditions of the service, and that only eight strainagraphs were available, made the data sufficiently scanty that no real analysis of the stresses can be made from the records.

THE "WESTBORO" RESULTS

During a complete round trip of the 8800-ton steel steamer "Westboro," built by J. F. Duthie & Co. at Seattle, simultaneous readings were taken at from 8 to 22 points of the cross-section of the ship, and rather complete data on the stress distribution in the ship acting as a longitudinal girder were derived. Typical results are shown in Figs. 7 to 10, of which Fig. 7 gives the essential dimensions and deck arrangement of the vessel, while Figs. 8 to 10 give stress-distribution curves.

Most of the measurements were made on a section about 10 ft. forward of the true midship point. The instruments were placed as marked in Fig. 8. Those on the bridge deck are denoted by the letters B; B and B_1 were really attached to the shell about 15 in. below the deck, and similarly M_1 and M_2 were attached

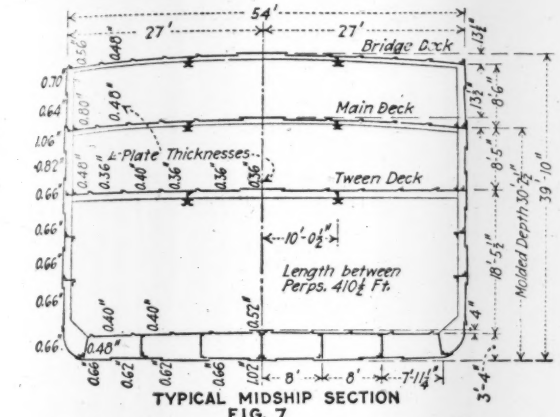


FIG. 7

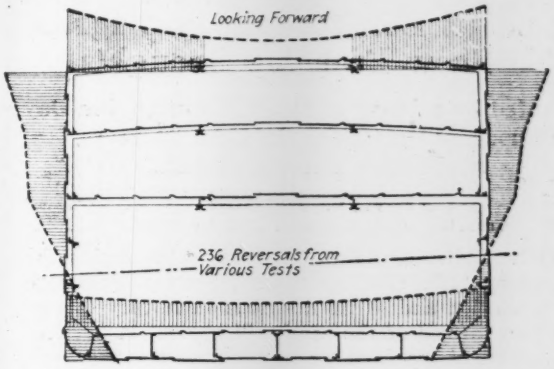


FIG. 9

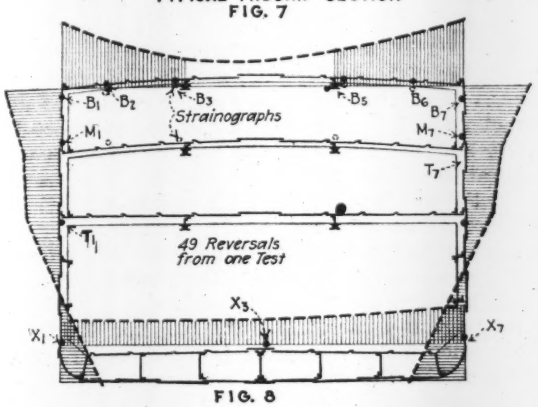


FIG. 8

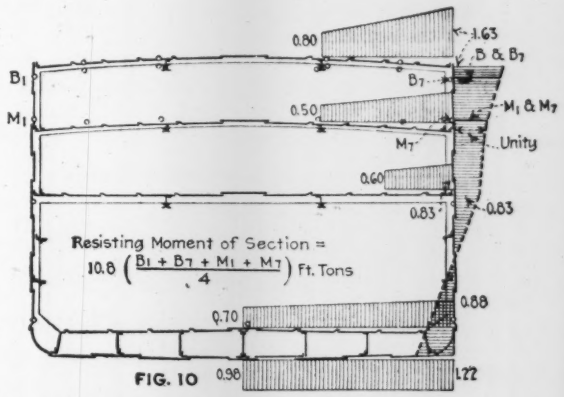


FIG. 10

FIGS. 7 TO 10. MEASURED STRESS DISTRIBUTION IN "WESTBORO"

Fig. 7—Dimensions and makeup of cross-section. Fig. 8—Stress distribution averaged from 49 reversals. Fig. 9—Composite of 236 stress reversals. Fig. 10—Characteristic stress distribution and moment formula

to the shell about 15 in. above the main deck, and T_1 and T_7 were on the shell just below the 'tween deck. Instruments X_1 and X_7 were on the shell slightly above the line of the tank top, but X_3 was attached to the tank itself, by a device that brought it about 8 in. above the plates.

Fig. 8 represents the stress distribution determined by averaging 49 reversals of stress from hogging to sagging. The position of the neutral axis agrees very closely with the calculated position. A further check on the data was obtained subsequently by placing two additional instruments, one between T_7 and X_7, and one farther around on the bilge, which agreed closely with the stresses indicated by the diagrams.

A large number of sheets similar to Fig. 8 were brought together for the figures plotted in Fig. 9. The curves here comprise the results of 236 reversals, taken from various tests and selected for a range of stress between 2000 and 8000 lb. per square inch, corner reading.

Because the stress distribution was found to be so uniform in character, a simple formula was worked out to represent the resisting moment in terms of the average reading from instruments at four principal points of the cross-section. The distribution by tests and the resulting formula are placed together in Fig. 10; the stress diagram here includes only those portions of the ship's cross-section which are assumed to act. In the curves of Figs. 8 and 9 a dotted line indicates that some stress was found in the deck plates between hatches, but as these plates were less effective at high stresses it is preferred to omit these areas in the stress distribution on which the formula is based, Fig. 10; an error of only 5% is involved by omitting the deck areas between hatches. The formula is simply the product of a constant and the mean of the stresses at the four corners of the main and bridge decks. It may be noted that the numerical values marked on the diagram in Fig. 10 indicate the stress at the bounding points of the various areas in terms of the stress at the main-deck line taken as unity; these fractions are derived from the measurements.

No instruments were directly placed on the 'tween deck, and it can only be estimated how much of its section was effective. Rather wide errors in estimating this, however, would affect the final resisting moment but slightly, on account of its nearness to the neutral axis.

It is clearly shown by the stress diagram, Figs. 8 and 9, that there is marked departure from a straight-line law of stress distribution in the shell of the ship. Furthermore, the stresses in the bottom plating are considerably below those in the decks, the neutral axis being only a short distance above the tank top. From a structural standpoint alone, therefore, the distribution of material in the structure of a ship according to present practice does not give equal utilization of the material throughout, but results in excessive deck stresses. Further tests now in progress and soon to be undertaken are expected to supplement these data and furnish confirmatory evidence concerning the relation between the shell stresses at different points.

Method of Constructing a Diagram To Show Probable Droughts

Illustrated by a Study of Rainfall During Ten-Day Periods, or Decades of Days, for 32 Years, at Kherson, European Russia

By V. V. Tchikoff
Consulting Civil Engineer, Berkeley, Calif.

In the studies of natural factors which decide the success or failure of agriculture, precise knowledge of precipitation and of its distribution is very important. The farmer of the semi-arid region, in particular, must adapt his farming to rainfall. On the basis of the most probable rainfall the farmer may select those plants whose maximum water requirements during their growth (the so-called "critical period") correspond with the sufficient amount of rainfall. For this purpose the farmer must first of all have a very simple and comprehensive idea of the probable drought during separate periods of vegetation. This need is satisfied by the diagram of drought which the writer applied

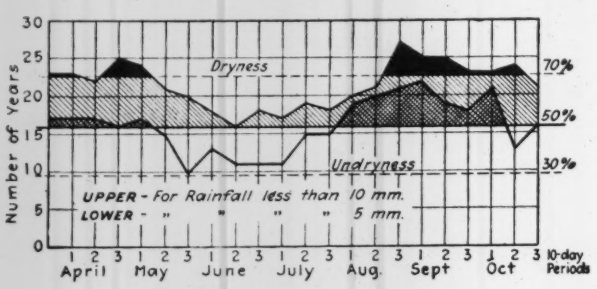


DIAGRAM OF DROUGHT FOR IRRIGATION STUDIES BASED ON RAINFALL AT KHERSON, RUSSIA

while studying irrigation problems in the lower region of the Dnieper River, near the City of Kherson, in the province of Taurida, Russia.

According to the observations of agricultural experiment stations, particularly in the black-soil belt of European Russia, it is established that a precipitation of 5 mm. (0.2 in.) does not in the least help vegetation, while in semi-tropical regions, such as Turkestan, it is even harmful.

For this reason Professor Brounoff, for a long time head of the agricultural-meteorological service in Russia, has applied the term "dry" to the 10-day periods during which precipitation does not exceed five millimeters.

For the southern section of European Russia, and particularly for the above-mentioned region about Kherson, where agricultural conditions are less favorable, because of warmer climate, winds and light soil, this amount may be raised to 10 mm. Such a decade of days (10-day period) we term "nonsatisfactory," to distinguish it from the one termed "dry." The accompanying table is based on observations made for 32 years (1883-1914) at Kherson, in view of the fact that the rainfall in that city presents the average for that region.

In the table is computed the probability of drought, in percentages, as the ratio of the dry and nonsatisfactory 10-day periods to the total number of 32. Only three norms are taken—30, 50 and 70%. The 50% norm designates equal probability of dryness and nondryness; the 30%, nondryness; and 70%, dryness. On the basis of this table one may easily construct a diagram of drought. The abscissas represent the 10-day periods, and the ordinates the number of cases with precipitation of less than 5 and 10 mm. The line parallel to the abscissa, through the points of 30% and 70%, limits the dry and nondry periods. The line through the point of 50% indicates the equal probability of dryness and nondryness. The shaded portions of the diagram represent the dry periods.

TABLE OF DRY AND UNSATISFACTORY DECADES OF DAYS

Month	Decade	Dry Decades—Rainfall Less than 5 M.m. Number of Cases	Probability of Drought, Approximate per Cent.	Unsatisfactory Decades—Rainfall Less than 10 M.m. Number of Cases	Probability of Drought, Approximate per Cent.
April	1st	17		23	
	2nd	17		22	
	3rd	16	About 50	25	About 70
May	1st	17		24	
	2nd	15		21	
	3rd	10		20	
June	1st	13		17	
	2nd	11	About 30	16	
	3rd	11		18	About 50
July	1st	11		17	
	2nd	15		19	
	3rd	15	About 50	18	
August	1st	19		20	
	2nd	20		21	
	3rd	21		27	
September	1st	22	About 70	25	
	2nd	19		25	About 70
	3rd	18		23	
October	1st	21		23	
	2nd	13	About 30	24	
	3rd	16	About 50	21	

This diagram demonstrates the fact that the farmer of the region under discussion is placed under difficult conditions. In the spring he must adapt himself for the length of five 10-day periods, since each of these periods is indefinite—the probability of drought being 50 per cent.

Only toward the summer may the farmer know with certainty that the rainfall per 10 days will exceed 5 mm. However, his prospect for "satisfactory" rainfall diminishes greatly if he should count on more than 10 mm. per 10 days. As far as the autumn decades (August-October) are concerned, they will all be dry, whether we take as the norm 5 or 10 millimeters.

The method under discussion examines each decade of days independently of the consecutive one; in other words, the dry period may extend to two, three or more consecutive decades of days. As an illustration, we may take the year 1909 in Kherson, when out of 21 decades of vegetation 18 decades were either "dry" or "unsatisfactory." It goes without saying that such periods result in a considerable failure of crops in the region.

Unfortunately, the question of the relation between the age of the plant and its water requirement has not been sufficiently studied as yet. But whatever data we possess on this question emphasize the particular importance of the brief, critical period in the life of the plant from the point of view of large crops. It is significant that in regard to corn crops in particular the United States Department of Agriculture states, ("National Weather and Crop Bulletin, No. 12, 1918, page 3"):

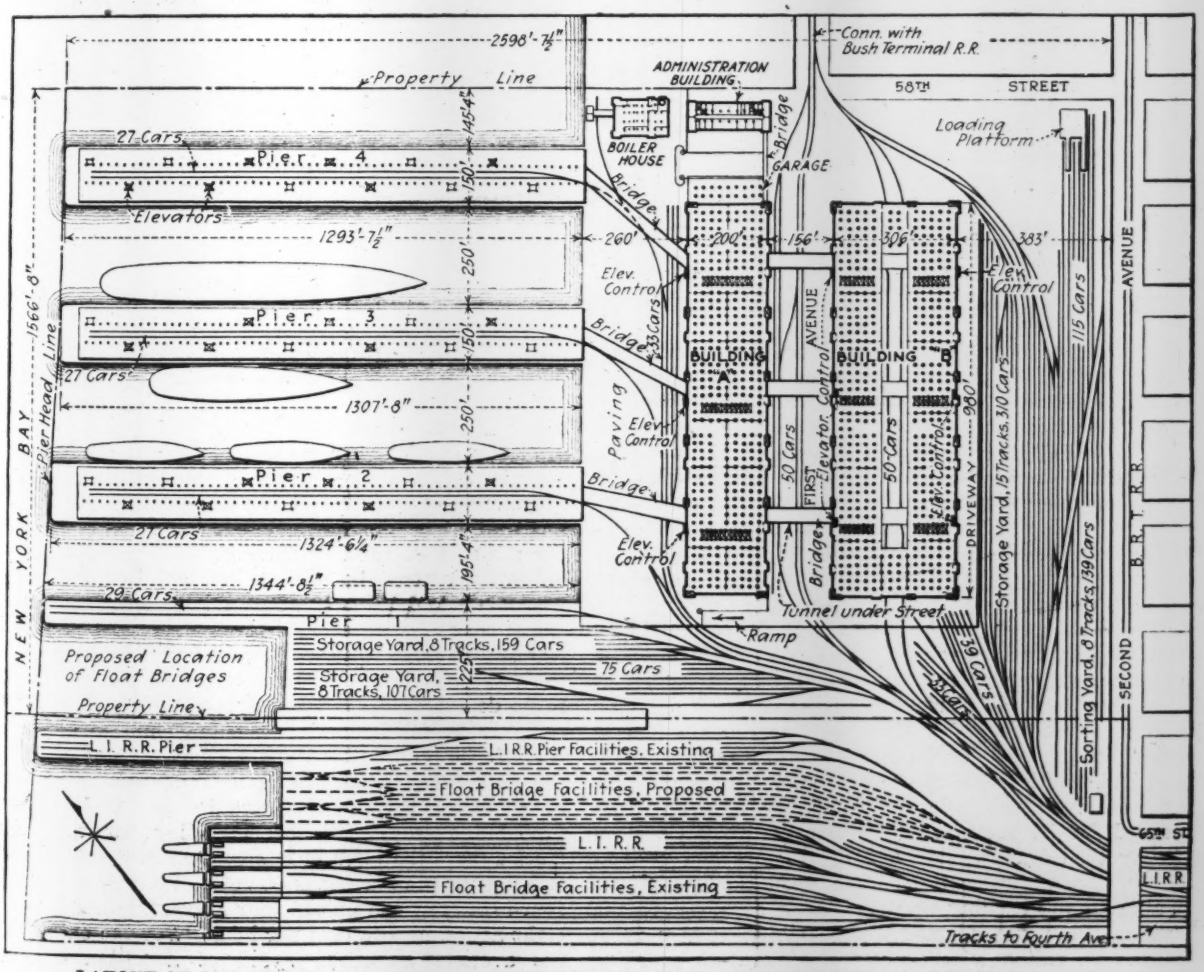
"The rainfall for the 10 days following the blossoming stage has an almost dominating effect upon the yield of corn, the yield varying directly with the amount of rainfall, provided the latter is not excessive. High temperature and dry weather during the 10 days after blossoming have a very unfavorable effect upon yield."

Freight Handling at the Brooklyn Army Base

Principles and Prospective Methods Which Controlled Design of the Huge Terminal Intended to Care for Army Overseas Business at the Port of New York

PORT terminals for the Army overseas were started in the spring of 1917, when there was every prospect of the war continuing for at least two years with the need of an ever-increasing stream of goods for the troops in France. The speeding up of outbound shipments was therefore the guiding consideration in design. Every effort was made to provide a freight-handling unit which would insure a maximum delivery of goods aboard a vessel, and the disposition of inbound freight, an important factor in a normal port terminal, was left to take care of itself. Before any of the terminals so built was complete, the war came to an end; the expeditionary force rapidly returned home, and the emergency need for the supply bases ceased.

Nevertheless, at seven ocean ports the Government had elaborate terminals, and at three of them, Boston, Brooklyn and New Orleans, permanent plants of a type easily convertible to commercial use. Just what disposition is to be made of these plants no one at the present time can say, but it is inconceivable that these terminals, developed so far in advance of any similar port development in the country, should not be utilized in commercial work. It is of interest to all concerned with freight-handling and port developments to set down the considerations which governed the design of one of these plants, that at Brooklyn, as an indication of how the unit may be operated as a two-way freight terminal that has ever been built. It was described in base has many novel features in the handling equipment, and it is, in addition, the largest-capacity freight terminal that has ever been built. It was described in *Engineering News-Record* of Feb. 13, 1919, p. 317. It comprises three double-deck ocean steamship piers, each 150 ft. wide and about 1300 ft. long, and one open pier 70 ft. wide, with two large warehouses and a freight-car storage yard. The piers are separated by slips 250 ft. wide and have two-story sheds with cargo hoists for ship-loading. Separated from the land end of the piers by an open space of about 260 ft. is warehouse A, and east of A on the farther side of a 150-ft. street is warehouse B. These buildings are the largest concrete structures ever put up, warehouse A being 200 x 980 ft. in plan, nine stories high, with a gross floor area of 1,764,000 sq.ft., and a storage capacity of 144,-



LAYOUT OF BROOKLYN ARMY SUPPLY BASE DESIGNED TO HANDLE OUTGOING FREIGHT AT RATE OF 1500 TONS PER HOUR

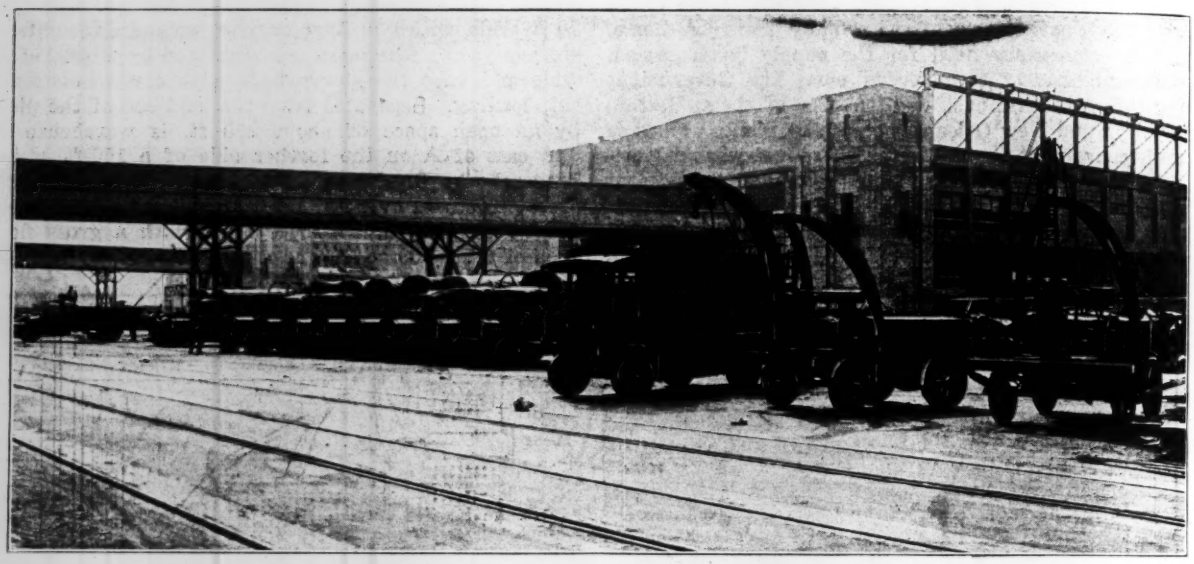
000 tons. Warehouse B is 306 x 980 ft. in plan, eight stories and basement high, and has a gross floor area of 2,130,000 sq.ft. and a storage capacity of 180,000 tons. The piers and warehouses are connected by bridges 40 ft. wide from the third floor of warehouse B to the third floor of warehouse A and from there to the second floor of the piers. The warehouses are further connected by tunnels running from the basement of warehouse B to the bulkhead level floor of warehouse A.

The car-storage yard in connection with the base has a capacity of 1295 cars, 179 of which can be unloaded at the piers or warehouses at the same time. Both warehouses are, in addition, approached by streets which permit 228 five-ton trucks to draw up to the warehouses at one time. The main piers have a gross dock floor of 1,220,000 sq.ft., or a storage capacity, assuming 80% of the first floor and 60% of the second floor for storage, of 180,000 tons, though in time of rapid movement through this terminal this would have to be reduced to very little, in order to allow space for the trailers and trucks. Further storage space for large and imperishable goods may be had on the bulkhead with an area of 350,000 sq.ft. It is a fair estimate that there is storage in the base for 15,000 carloads of goods, or, at the estimated outgoing movement of 1500 tons per hour, a 30-day storage.

The problem of freight handling at the terminal was to provide a flexible, reliable and rapid system whereby the maximum number of ships which could lay up at the piers could be loaded at the same time that the maximum number of freight cars and motor trucks could be unloaded, utilizing a part of the pier space and bulkhead level space and all of the warehouse space as a reservoir for freight. The design as evolved depended for its solution on the use of group elevators for vertical transmission and of tractors and trailers for horizontal transmission, and upon the use of the trailer as a bunching station. As a corollary to the system there was adopted a dispatching system from a central station with operatorless elevators provided with an automatic leveling device.

In the operation of the base, freight is received by motor truck and by train, both of which can draw up to the warehouse and go onto the bulkhead space and onto the first floor of the piers, and by lighters which can draw up to any of the piers or to the slip side of the ships at the main piers without blockading the slips. By far the greater part of this freight is stored in the great warehouses, there to be withdrawn as required to the ships at the piers. But it was also anticipated that some freight would be delivered direct to the piers by trucks and cars and to the side of the ships by lighters. This direct delivery, however, is assumed to be emergency or reservoir material.

The handling facilities in the warehouse are designed to take care of the maximum loading facilities at the piers. There were, therefore, two controlling elements in the handling equipment design: The maximum incoming freight transported from delivery doors to the various warehouse floors, and the maximum outgoing freight from these floors to the piers, mainly via the third-floor bridges but partly via the basement tunnels, and the street level of the bulkhead space or "farm," as it is called at the base. Since this movement might be simultaneous, provision had to be made for the sum of the two amounts to be handled.



SOME OF THE FREIGHT-HANDLING EQUIPMENT ON THE BULKHEAD SPACE BETWEEN PIERS AND WAREHOUSES

Emphasis must be laid on the fact that the design was made to take care of maximum operating conditions; that is, with every section of the great terminal working at once. On that basis the unit working capacities, as applied to the whole terminal, had necessarily to be decreased from what is possible for the unit itself. It is, for instance, possible to unload a five-ton truck in 30 min. without undue effort. As noted below, the unit time for unloading a truck was assumed to be 2½ hours, because that was thought to be a more probable *average* time of unloading for the motor trucks, more than 200 in number, which it was possible to bring to the platforms at once. So, too, an average four-man crew can unload four average railroad cars in eight hours, or 12½ tons per hour. For the entire base the average unloading speed of a 25-ton car was selected at five tons per hour. The computations given

below, therefore, are the design figures and give the assumptions of the designers. They do not necessarily represent working figures for the base as a commercial terminal, nor do they represent the peak possibilities of the base for a limited period.

As stated, it was assumed that the average loading of a freight car was 25 tons, and that the time of clearing that car would be five hours, giving five tons per hour as the unloading speed. At the same time it was assumed that the average load of a motor truck reaching the base would be five tons, and the time of clearing 2½ hours, or a speed of two tons per hour per truck. Although this latter figure is obviously high for the unloading speed of a single truck in the Army base computation, it was felt, taking into account the lack of storage space on the comparatively narrow platforms, the time required by the trucks in getting in and out the base and in spotting the incoming truck at the platform—and, above all, the doubt that there ever would be such an available supply of loaded freight trucks as to guarantee the simultaneous unloading of all which could possibly draw up to the base—that the more liberal figure of 2½ hours per truck would be justified.

Warehouse A has space on the First Ave. side for the unloading of 24 cars or 80 trucks, on the 59th St. side space for 20 trucks, and on the bulkhead side space for 19 cars, via whip-hoists which have not yet been installed but which can be put in if required. The nearest track on this side of warehouse A was spaced 70 ft. away from the building to provide proper working space for the whip hoists. Assuming the maximum delivery, therefore, for warehouse A, there would be 100 trucks at 200 tons per hour and 19 cars at 95 tons per hour, making a total of 295 tons per hour reaching that building; or 262 tons to be elevated to the other eight of the nine floors. In warehouse B there are unloading accommodations for 128 trucks and 50 cars, a total of 450 tons to the other eight of the nine floors.

Outgoing freight, as stated above, must be assumed to be equal to the capacity of the piers. These piers have accommodations for 12 ships, and it is assumed that there will be five hatches per ship. The best loading speed obtainable for general cargo, with the methods in vogue in New York harbor, is about 25 tons per hatch per hour, and it was assumed that even though this should be increased by better methods, the surplus above that could well be taken care of by the reservoir freight noted before to be held on the piers in the bulkhead space or on the lighters. In 60 hatches, 1500 tons per hour would be the outgoing-capacity demand of the two warehouses. It was then assumed that warehouse A, being nearer the piers, would take more than its capacity proportion of this demand, say one-third more than that amount. According to floor areas, of the 1500 tons warehouse A should take 450 and warehouse B should take 1050. In the design, however, it was assumed that 600 tons per hour would be shipped from warehouse A and 900 tons per hour from warehouse B. The elevator capacity required is only eight-ninths of the total amount, or 534 tons per hour for A and 800 for B.

	Warehouse A	Warehouse B
Incoming	262	450
Outgoing	534	800
	796	1250

These amounts and speeds are unprecedented in warehouse design. It was assumed as a basic principle in such layout as this that the only method of transferring the freight was by horizontal movement on trailers and trucks and vertical movement in elevators. With such a system, high speed has to be maintained throughout, and there must be no interference in the routing of the many-directioned freight, there must be as little rehandling as possible, and the whole layout must have a minimum of cost.

To facilitate the minimum rehandling and speed, it was decided that the freight must be transported on the same conveyor without rehandling from the point of original loading to the point of final disposition, which in this case was either from the loading platform to storage space or from storage space to the piers adjacent to the ship's hatches. This, then, established the trailer-and-truck idea. In order to maintain a satisfactory capacity it was necessary to have fairly large trains, and it was assumed that it would be possible to operate eight trailers with a truck. This, then, required large cars for the elevators, cars capable of holding at one time at least four of the trailers. In order to insure that there would be no interference in the routing, it was decided that the elevators, instead of being scattered over the building in small groups as is common in such warehouses, should be gathered together in large groups. This was a radical innovation and required the next step in the design; that is, that there be such a distribution of the freight in movement as to assure the absence of congestion in and about the elevator groups.

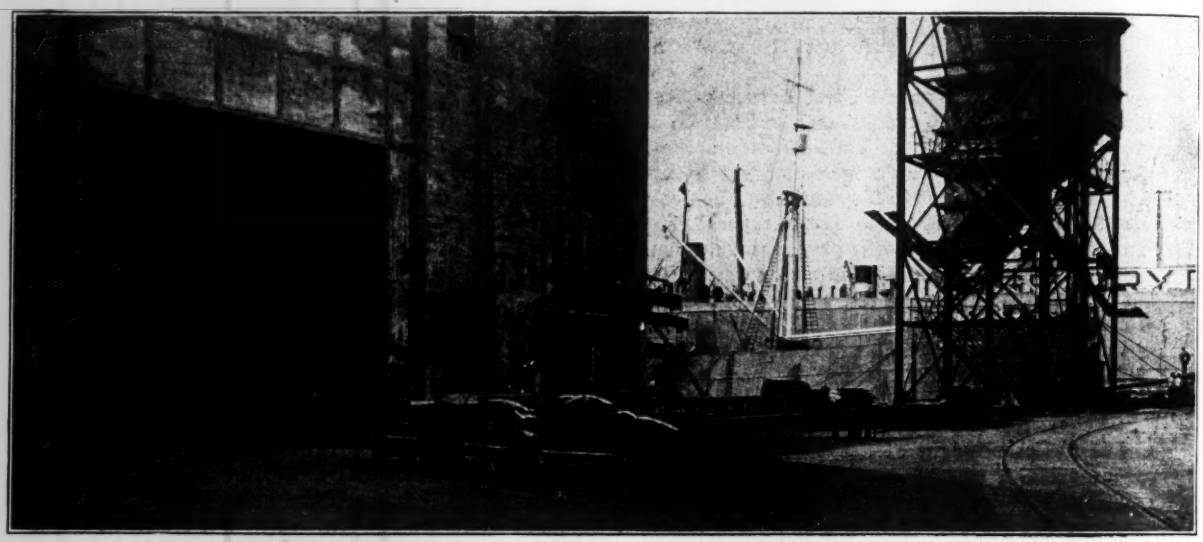
TRACTOR WITH TRAILER TRUCKS COMING FROM ELEVATOR

To insure this easy movement at the groups, the cars were designed as double-ended, with the tractor trains entering on one side and making their exit on the other, and, furthermore, it was necessary to establish a dispatch system, so that at some central point there could be supervision of the movement of the trains and the elevators, and control of that movement. As a final result of this dispatch-system idea, then, the elevators had to be automatically controlled from this system, and had to have an automatic leveling device whereby they would come to a stop level at each floor, to permit the trucks to be run on and off.

As a result of these successive deductions, the elevators were laid out as shown on the drawing; that

is, in three groups in building A and six groups or three twin groups on either side of the central court in building B. The elevators were designed to have a speed of 150 ft. per minute and an average running time of approximately 1 min. for the round trip. Allowing for loading and unloading, closing doors, and all other delays, the time of the round trip was assumed to be about 4 min., but as a wide margin of safety was desirable it was assumed that each elevator would make ten trips per hour and move four truckloads or 30 tons of freight per hour. The total number of elevators required is dependent on the maximum quantity of freight to be carried during any given period and the number of trips each elevator can make per hour, which is contrary to the practice, in designing many warehouses, of laying out the number of elevators to bear some fixed relation to the floor area.

As the maximum requirements of warehouse A were 796 tons per hour, at 30 tons per hour per elevator 27 elevators would be needed. For B the requirements



TRACTOR TRUCK TRAIN ON WAY INTO FIRST FLOOR AT ONE OF THE PIERS

of 1250 tons per hour would demand 42 elevators. These would be the elevator requirements were the elevators working all the time and with an equal distribution of traffic through the warehouse. On account, however, of maintenance necessity and to afford leeway in the distribution of the freight to various sections of the building, the requirements were changed so that in building A each group had 10 elevators; that is, three groups, making a total of 30, instead of the 27 theoretically demanded, or one extra elevator in each bank. In building B seven elevators are provided in each of six groups, giving a total of 42.

This layout provides one elevator for each 59,000 sq.ft. in building A and for each 50,500 sq.ft. in building B. In order to take care of four trailers at once each car was made 9 x 17 ft. in plan, an exceptionally large size for warehouses, and with a capacity of 10,000 lb. In addition, there are passenger elevators to take care of the office force. Further movement of freight in warehouse B is to be accelerated by five-ton traveling girder cranes, spanning the central court, which will pick up bulk freight from cars or platforms and drop it on trailers run out on the staggered balconies in the court.

The elevators were specially designed for the operations as laid out. The automatic leveling device is a feature of elevators of the Otis Elevator Co., which made the elevator installation. The distinctive feature of this machine is the addition of a small auxiliary motor known as a micro-drive mechanism, so geared to the main drum that it will turn at slow speed. When the car platform, going in either direction, is within 8 in. of the landing, the power of the main machine is automatically cut out and the brakes are applied on the drum shaft, and at the same time the "micro" machine is connected and completes the movement to the landing by turning the brake frame to which it is geared and so turning the drum shaft at a slow speed. From a point 8 in. above to 8 in. below the landing at which the car is to stop, the "micro" machine is operating, except only at the exact level of the landing, at which point it is disconnected. The contact points at the floor at which the car is not required to stop are moved by means of a solenoid. As the points of contact controlling the machine are on the wall of the shaft and the body of the car itself, there can be no change in adjustment due to stretching of cable or other changeable factors. If the car moves even very slightly, due to lightening or increasing the load, or other reasons after the stop is made, electrical contact is made and the motor brings the car back to the landing.

Doors at either end of the elevators are automatically operated from a chain extending from top to bottom of the hatchway and return. These doors open when the elevator reaches the floor, but are closed by the pushing of a button at the floor. An interlocking switch is provided, which prevents the elevator leaving the floor until the door is closed. The doors open and close quickly and are checked and brought to a gradual stop without slamming. They are evenly counterweighted and operated by a friction clutch, with no more power than is necessary to overcome the friction, so that they will stop with little force at any obstruction, and

no serious harm could result if a person should be caught under the door. The doors are complete, closing from the top down and not split in the middle as in some types of warehouse elevator.

On account of the comparatively limited story heights, it is necessary to project an opening door far enough into the hatchway for it to pass between the car top and the sill above. This has been accompanied by an arrangement of rocker arms which, when the door has been lifted 18 in., shifts it from the vertical plane of the sill to a plane entirely within the clear elevator shaft, where it rises the full height of the opening.

The automatic leveling device has made practicable the application of push-button operation to the freight elevators here. On the third floor, which is the main operating floor, is a central dispatcher's desk located opposite each elevator group. On this desk are two buttons for each of the other floors, one to dispatch the car to that floor, the other to call the car from that floor. An interlocking switch prevents the car being called from the floor unless the elevator doors are closed at that floor. At each of the other floors there is one dispatch button only, to send the car to the dispatch floor. Each elevator is also equipped with car switches, for operation in the usual way by an operator on the elevator. When these switches are in operation the dispatch control is thrown out of gear.

These dispatch stations command a view of the front of the elevators and of the trailer trains coming off the bridge. Each dispatch board controls the whole group of elevators for all of the floors. The operator is in constant telephonic communication with each of the floors and with the piers as well as with the director of traffic; by means of the signal lights on his dispatch board he has before him at all times the position of all the elevators of his group, and by telephonic communication has information concerning the state of loading and the requirements for the load.

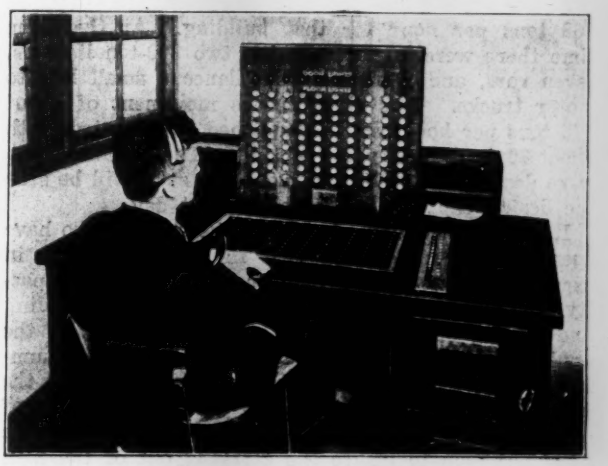
As stated, freight is to be carried on small trailers drawn by electric tractors. The average load of each trailer is about 1500 lb., and the trailers will be operated in trains of from four to eight. In addition, there are a number of minor freight-handling devices, such as portable cranes, tiering machines, etc., for transfer in the yards and warehouses. The list of portable equipment on Sept. 1 was given as follows:

EQUIPMENT

	Number
Tractors, Walker Model No. 7	2
Tractors, Walker Type, D.K.	10
Tractors, Type 64-L 4th Mercury	47
Tractors, Galion Dyn.	1
Tractors, Walker Elec., eight-ton	1
Tractors, Lansing, five-ton	1
Tractors, Walker Elec., 14-ton	6
Tractors, Hoist, Crane	4
Trailers, Four-Wheel, Dock	5
Trailers, Rey, Lansing	60
Trailers, Lansing, Equip. HRB	1000
Trailers, Four-Wheel	51
Trucks, Three-Wheel, dock	6
Trucks, Hand	500
Trucks, Large, hand	178
Trucks, Small, hand	93
Trucks, Four-Wheel, Tea	5
Trucks, Logwood	3
Trucks, Rey., Asst. Veh.	100
Trucks, Four-Wheel Fig. 736	100
Trucks, Lansing, Hand, Two-Wheel	150
Trucks, No. 9-48 Steubing, hand	20
Trucks, Seattle dock	129
Trucks, Three-Wheel, dock	84
Trucks, Walker elec., five-ton	17
Machines, Tiering	7

On each pier there are six 17 ft. x 9 ft. 4 in. elevators of the same type as those in the warehouses except that they have a speed of 100 ft. per minute, are not in groups but are spaced one by one down the pier, and are operated individually by means of buttons on each floor and in the car. Space is provided on the piers for other elevators or for chutes, etc., but the equipment is not installed. The goods will be lifted in and out of the hatches from cargo hoists. Consideration was taken of various other methods of handling the freight between ship and pier, but the conclusion was in favor of the cargo-hoist type practically universal at New York City piers. On the lighter pier traveling gantry cranes are provided.

At each floor, when receiving and discharging are in progress, there should be a continuous movement of loaded trailer trucks toward the elevators and empty trucks (or, in case of two-way movement, trucks with loads from the ships) from the elevators. The trucks are to be placed on the elevators, and make continuous trips from the point of loading to the point of unloading and return, as, for example, from the storage floor on the upper floor to the pier. The tractor moves only from point to point on the same floor. This results in three main circuits of travel for each group of elevators, proceeding simultaneously: (1) On the first



ELEVATOR CONTROL BOARD IN ONE OF THE WAREHOUSES

floor between unloading platforms and elevators; (2) on the third floor between elevators and piers; (3) on upper floors between storage spaces and the elevators.

Trailers after leaving the elevator are to be made up in trains ready to be taken away by one of the tractors on that floor, and trains of empty trailers will be broken up on the opposite side of the elevator and placed in a position to be moved onto the elevator as soon as it arrives at the floor. Space has been provided for this purpose on both sides of the elevators, and the traffic movement will always be counter-clockwise without interference between the paths of loaded and empty trains. At the third floor the loaded trucks will be removed from the elevator and made up of trains of from six to eight trailers and drawn to the pier by tractors. The train will be left on the pier for unloading, and a train of empties or of trucks loaded from incoming ships will be picked up by the same tractor and drawn back to the elevators.

For this service it was assumed that there had to be a traffic flow to each pier to supply four ships; that is, 500 tons per hour. From this it was assumed necessary to have 83 trains, of six tons each, pass over

the bridges in each direction per hour; in other words, trains are drawn at about ¾-min. intervals. The speed when loaded is about 3½ miles per hour, or approximately 300 ft. per minute, so that the headway would not greatly exceed ½ min. On account of the close running, the bridges have been designed wide enough for two trains to pass in each direction.

At present the two warehouses are practically full of Army supplies in dead storage, awaiting some disposition. This material reached the base mostly by train and not in any quantity taxing the resources of the equipment. At the same time there are a few ships unloading and loading. The operation at the base, however, has never approached capacity, nor have the methods of operation had to be developed beyond somewhat primitive details. In so far as the proposed operating system has been put into effect it has proved successful. For concentrated movements there have been several records far ahead of the design provisions.

For instance, in one 8-hour day there were received into building A 119 carloads, two lighter loads at 260 tons each, and 340 tons for motor trucks, a total of 3835 tons, or 479 tons per hour, as against the estimated 262 tons per hour for that building. At the same time there were loaded outgoing two 300-ton lighters, seven cars, and numerous miscellaneous small lots to motor trucks. This simultaneous movement of about 575 tons per hour was accomplished, it is stated, with about 60% of the elevator capacity. The elevators in A were designed for 796 tons per hour, so it will be seen the design capacity was exceeded that day.

It is the contention of some of the experts who have been operating the plant that its capacity is far in excess of that noted in the design. The increased capacity would be found, of course, in a more rapid unloading and loading of the cars and trucks, or, rather, in the application of the possible unit speed to the great number of cars and trucks which can be drawn up to the platforms. This would require a careful system of operation to avoid congestion and a constant vigilance of supervision to insure the carrying out of the plan of operation. The systematic operation, too, would be helped by the method of control of the handling through the centrally controlled elevators and dispatch system. There seems to be no doubt that the elevators could be speeded up somewhat above their design rate and the tractor-truck system inside the buildings manipulated at higher efficiency than provided for in the design. Then, too, the whip hoists and the girder cranes provide excess service.

On the other hand, there is a reasonable doubt whether the total ship-loading speed can be increased with the present layout, and as the pier end of the terminal is the controlling element in its operation, doubt is cast on the possibility of increasing the capacity of the terminal beyond its design limits. While it is possible that the estimated 25 tons per hour per hatch is a fair estimate of the loading capacity at any one hatch, fear has been expressed that with all the berth space filled, either with incoming or outgoing ships, the pier space itself would become so congested with freight moving by truck, tractor truck or train that it would be difficult to maintain the maximum loading in all hatches. In this event all of the speeding up possible In the warehouses themselves would not increase the capacity of the terminal as a unit, but would only increase the congestion on the piers. To maintain even the design rate of movement through the piers without congestion requires the most careful control of traffic, so that, after all, the operation of the terminal comes down to a question of supervision.

The Brooklyn Army Supply Base was built by the United States, under the direction of the Construction Division of the Army, Brig. Gen. R. C. Marshall, Jr., in charge. Lieut. Col. H. S. Crocker was the constructing quartermaster, Cass Gilbert was the architect, and the Turner Construction Co. the general contractors. The design of the freight handling was the joint product of the general contractor and the various equipment people concerned.

Empiric Formula for Strength of Wire Rope

AS A RESULT of extended tests of wire rope, reported by J. H. Griffith and J. G. Bragg in "Technologic Paper 121" of the United States Bureau of Standards, empirical formulas are proposed by which both the area of steel wire and the strength of wire rope may be ascertained. The tests were made upon 275 wire ropes varying from ¼-in. to 1½ in., with a few up to 3½ in., submitted by manufacturers to fulfil the specifications framed by the Isthmian Canal Commission in 1912. Results of the tests of 2-in. to 3½-in. ropes were published in *Engineering Record* of July 15, 1916, p. 81, where details of the method of testing and the socket bowl and grip piece are given.

The mean diameter of the wires, according to the measurements of these ropes, may be expressed:

$$d = K \frac{D}{N + 3}$$

in which d equals the diameter of the wires, D = the diameter of the rope, N = the number of wires in the outer ring of wires of a strand, and K = 1.0 for hoisting and guy rope, 0.8 for extra-flexible 8-9 hoisting rope and 0.33 for tiller rope.

The aggregate cross-sectional area of the wires may be expressed by $A = C D^2$, in which C = 0.41 for 6-19 plow-steel hoisting rope, 0.38 'for 6-19 crucible steel hoisting rope and for 6-7 guy rope, 0.35 for 8-9 plow-steel rope, and 0.26 for 6.42 iron tiller rope.

The minimum strength found from this investigation may be expressed by the equation, $S = 75{,}000\ C\ D^2$, in which S equals total strength in pounds, and C averages 1.0 for 6-10 plow-steel cables, 0.9 for 8-19 plow-steel and 6-19 crucible cast-steel cables, and 0.35 for iron tiller and steel guy rope.

The modulus of elasticity, calculated from stress-strain measurements, was found to vary from 3,000,000 to 9,000,000 lb. per square inch, depending upon the diameter and class of cable.

There was a reasonable uniformity in the strengths and elongations of the wires from a particular cable, but a larger variation in the strengths of the wires from cables of different manufacturers.

The cables developed from 72 to 90% of the aggregate strengths of the wires. The upper limit of the ratio of the strength of a rope to the strengths of its wires was found from theoretical considerations to be 89.2% for 6-19 plow-steel cables. The differences between the results of the theoretical analyses and practical tests are attributed largely to different strengths and degrees of ductility of the wires, this causing an unequal distribution of the load among the strands, with overstressing near the point of failure.

National Public Works Department Versus Corps of Engineers

Passage of Jones-Reavis Bill Urged on Ground That Great Harm Would Result From Injection of Military System Into Activities of Civil Life

By Isham Randolph
Consulting Engineer, Chicago

THE United States Engineer Corps is a body of men justly proud of its record, but hostile to any movement which threatens its authority or reduces its field of action. It has on its roster the names of many men who deserve credit for high attainments. Their country had educated them and made them a class apart, invested with authority and clothed with dignity. They have been entrusted with vast responsibilities, and for the most part have discharged those responsibilities worthily, but not without the advice and help of untitled civilian engineers, who have paid for their education and gotten their experience without the aid of a paternal government. It is these men who have done the vast proportion of the work for which men who wear insignia of military rank have been accorded, and have graciously accepted, the credit.

Extent of Corps Operations

A statement of the vast area of the field of operation of the Corps of Engineers is a fitting preface to what I am about to say. Continental United States has an area of 3,742,583 square miles, within which are 26,410 miles of navigable rivers, 1,200,000 square miles of arid lands, and 75,000 square miles of swamp lands. Our continental and insular coast line is 48,881 miles long, not including our water-front on the Great Lakes. We have between 35 and 40 continental ports, besides all those in our insular possessions. There are 517 West Point engineers to care for this vast array of work, as shown by the "Statement Showing Rank, Duties and Addresses of the Officers of the Corps of Engineers," issued by the War Department Jan. 1, 1919. They are divided as follows:

	Active	Retired
Major Generals	1	2
Brigadier Generals	...	2
Colonels	23	6
Lieutenant Colonels	30	3
Majors	74	..
Cpatains	151	1
First Lieutenants	148	..
Second Lieutenants	76	..

A large proportion of these captains and lieutenants were rushed through West Point without completing the course of study. We have, then, old and young, experienced and novices, 517 officers to do the vast work suggested by the citation previously made. There are in the United States over 100,000 engineers in the various lines coming within the term engineering. Thousands of these men responded to war's compelling need; the American Society of Civil Engineers supplied more than 1500; the Western Society of Engineers, 148; the American Society of Mechanical Engineers, 1497; the American Institute of Mining Engineers, 739; the American Society of Electrical Engineers, 1412; the American Society for Testing Materials, 575. The Architects sent hundreds.

These were not novices, but men who, when the need was presented, were able to meet it, and their record of achievement is a proud one. They know that they have earned recognition from the Government. They are so self-respecting that they are not willing, now that the piping days of peace have returned, to do the planning and the work which must be done along their several lines and submit their work to a military engineer who, as a matter of form, will attach his name to the plans and, as a matter of course, accept the credit which goes with the work.

Military engineers are educated to meet the constructive and destructive needs of war, and war has demonstrated to the United States its need for them. They do not fit into the every-day life of a democracy. Their training makes them autocratic. Most of them, however, have the instincts of gentlemen and they deport themselves as such, but the officer is a rare exception who can wholly divest himself of a superior attitude toward the civilian. The feeling may be successfully camouflaged, but it is only in concealment.

Civilians Deserve Credit

We think that no record will disclose a structure designed for the uses of peace and erected under military direction which has been designed, supervised, and completed wholly by the military engineer without aid or counsel from some civilian engineer. In support of this statement the Sault Ste. Marie locks and the Panama Canal are in evidence. Are not the skill and brains of Alfred Noble, Joseph Ripley, L. C. Sabin, David Molitor, Isaac De Young and many other civilians built into the Sault structures? Then take the Panama Canal. It is to the glory of the Corps of Engineers, U. S. A., that it was in charge of that tremendous project, and the names of Goethals, Sibert, the beloved Gaillard, and Hodges will always flash upon the screen of memory when that work is thought of, and *they* have had recognition and reward; but we, who know, will also remember Williamson, Goldmark, Schildhauer, Cornish, Zinn, Nichols and their civil associates. Alfred Noble, too, left his impress upon that great work.

The Pacific Division had as its chief S. B. Williamson, civilian, all of whose aids were civilian engineers. An examination of the Chief Engineer's report for 1913 ("Vol. VI, Statement of Construction Expenditures to June 30, 1913") shows that the military on the Atlantic Division built 2,265,415 cu.yd. of masonry for $16,993,254.33, or an average of $7.50 per cubic yard; and that the civilians on the Pacific Division built 2,453,320 cu.yd. for $13,646,113.96, or an average of $5.56 per cubic yard; showing a civil economy of $1.94 per cubic yard over the cost of the Military Division, or a saving of $4,745,515 on the job. Did Williamson ever receive any recognition from Congress? He did receive it from a business organization to which his achievement recommended him. Did any one of his civil associates receive commendation or reward from Congress? If so, when, and what was it?

Furthermore, we know that the Army Engineer officers did not plan the Panama Canal. The type and salient features of that canal were worked out by a minority of the International Commission for the Isthmian Canal. To the project thus prepared the Army Engineers fell heir—a project changed, except as to dimensions, in only one particular. The lake which the minority planned on the Panama side of the Culebra cut, with a dam across the Rio Grande and locks between Sosa and Ancon, was abandoned because locks in that location would be within range of gunfire from warships. The locks were moved back to Miraflores,

and a large item of cost was added to the work. The wisdom of this move from the military standpoint could not be questioned then, but the world war has shown such advance in the power of modern artillery, and indirect fire has reached such precision of aim, that the interposition of a hill and the withdrawal for a few miles count for but little as a means of defense.

I have grown old in engineering service, and I have been in touch with military engineers for forty-odd years. I have admired, valued and still value the friendship of many of them. But I have not learned to admire the system which environs them, and I believe that the injection of that system into the activities of our civil life is a harm so great that it needs to be abated, as it will be, by the passage of the bills providing for a national Department of Public Works introduced June 25, 1919, in the Senate by the Hon. Wesley L. Jones and in the House by the Hon. Frank G. Reavis. The 100,000 or more engineers of our country should use every honorable influence and means to secure that legislation.

Highway Bridge Floor Replaced After Corrosion

Pottstown Bridge Over Schuylkill River a Typical Case of Deteriorated Floor System—New Steel Protected—Lower Chords Open

TYPICAL of the defective design of many highway bridges in respect to protection from deterioration due to corrosion, particularly in the floor system, is the Pottstown bridge over the Schuylkill River in Montgomery County, Pennsylvania, the entire floor of which had to be replaced after an inspection in 1916. The bridge is situated in Pottstown. Several effective details were adopted to protect the new steel-concrete covering for the tops of transverse floor-beams, complete encasement of steel at abutments and over the piers; rearrangement of sidewalks to leave the lower chords and joints entirely open; roadway planking waterproofed and drain holes to control water. The wood-block pavement was laid directly on the plank without sand cushion, and the badly rusted end rollers were replaced by sliding plates of manganese bronze and steel.

This bridge consists of two through pin-connected Pratt-truss spans, each about 180 ft. long between end pins, with eight panels nearly 22½ ft. long. The roadway is about 18 ft. clear, and 5-ft. sidewalks are carried by brackets outside of the main trusses. The bridge was built by the Phoenix Bridge Co. in 1884; the top chords and compression web members consist of Phoenix columns, the bottom chords of eyebars, and the web members of eyebars and rods—all of wrought iron.

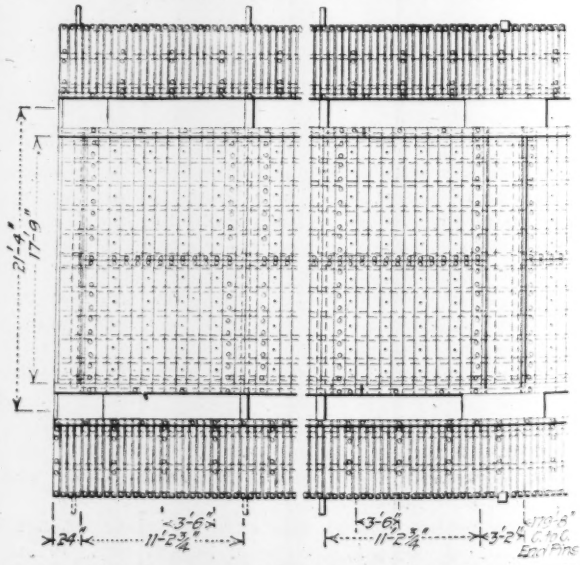
The old floor-beams were riveted girders suspended at the panel points from the truss pins, by rod hangers. These floor-beams carried two lines of riveted stringers adjacent to the trusses, which stringers supported the intermediate riveted floor-beams that subdivided the main panels of the bridge. The longitudinal stringers were six lines of 6-in. I-beams resting on the top flanges of the floor-beams. The footwalk planking was supported at one side by the roadway floor curb timbers, at the other by the hand railing, and in the middle by 5-in. I-beams, and consisted of 2-in. planking secured to spiking pieces. The roadway floor consisted of one thickness of 3-in. oak planking similarly secured.

At the time of the inspection in 1916 typical evidences of deterioration were found. The roadway planking was worn and in bad condition, and the spiking pieces, both under the roadway and under the sidewalk, were badly rotted so that they did not hold the spikes; consequently, the planking was loose and springy. The riveted floor-beams and the main stringers were in fair condition, but some loss of section was found in the top flanges, due to rust. The I-beam stringers were very light and in bad condition, showing considerable loss from rust in the top flanges.

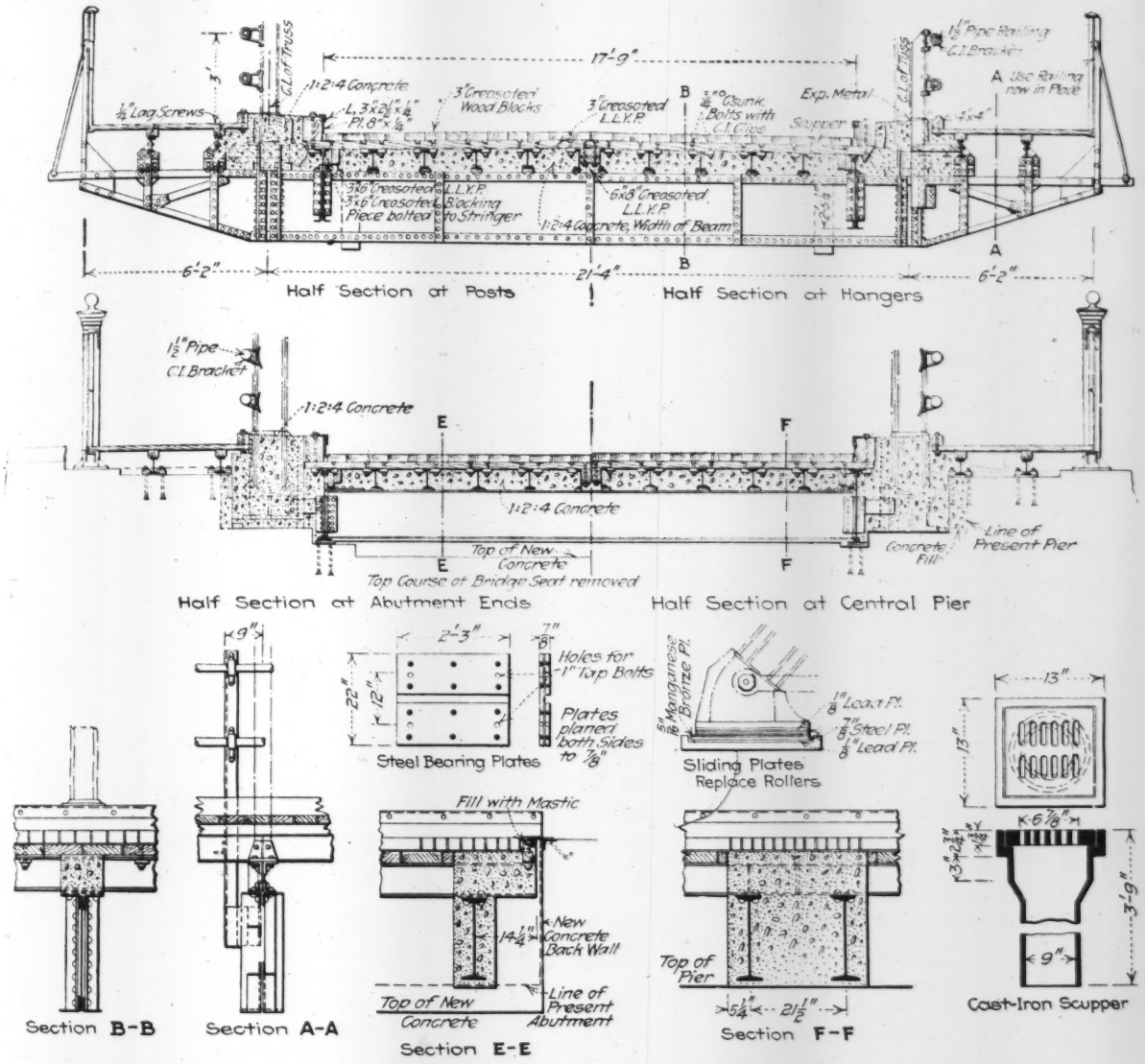
In general, the ironwork of the trusses and overhead bracing was in good condition, showing little signs of corrosion. The lower ends of some of the intermediate posts, where they rest on cast-iron joint boxes, and the lower ends of the main end diagonals at and below the floor, showed rust, but apparently the loss of section was not serious. Some of the counter rods in the trusses and the top and bottom lateral rods were found to be slack and needed tightening. The roller nests under the expansion ends of the spans on the end abutments were badly rusted, so as to prevent movement under temperature changes. The paint on the ironwork was in particularly bad condition.

Truss Strength Sufficient—The drawings from which the bridge was built showed that the trusses were designed for a live load of 2000 lb. per lineal foot of bridge. If this be considered for the 18-ft. roadway only, it would be equivalent to a live load of 111 lb. per square foot; if applied to the 18-ft. roadway and the two 5-ft. sidewalks, the loading would be equivalent to 71.4 lb. per square foot. Allowing for the additional weight of a new steel floor system and 3-in. wood-block-pavement laid on 3-in. planking, the live-load carrying capacity of the trusses would be as follows: Considering 18-ft. roadway, 75 lb. per square foot; considering 18-ft. roadway and two 5-ft. sidewalks, 50 lb. per square foot. These live-load carrying capacities were considered sufficient to meet traffic requirements in this vicinity for a long time.

The floor system, however, was so weakened by deterioration that it had to be completely replaced. The roadway stringers, particularly, were too light and too



PLAN OF FLOOR AT END PANELS, SHOWING LOCATION OF BOLTS



CROSS-SECTIONS AND DETAILS—FLOOR REPAIR AND PROTECTION AT POTTSTOWN BRIDGE

shallow for proper stiffness. The new floor system had to be designed along the same general lines as the old, but, instead of the six lines of 6-in. I-beams, eight lines of 8-in. stringers were used in the replacement. Many of these stringers were obtained from the Port Kennedy bridge, which was similarly rebuilt about the same time. The new floor was designed for loaded trucks weighing 15 tons, assuming 20,000 lb. on the rear axle and 10,000 lb. on the front axle, with axles placed 12 ft. apart. One concentrated wheel load was considered to be distributed over two stringers.

Wood Block Laid Direct on Planking—A new floor was designed with 3-in. creosoted yellow-pine planking laid directly on top of the steel stringers and bolted to the same with cast-iron clips and ¾-in. bolts, as indicated in the plan view, no spikes whatever being used to secure the roadway platform. This detail was selected in order to avoid the use of spiking pieces, which deteriorate rapidly, and also to reduce to a minimum the corrosion of top flanges of stringers which is a marked characteristic of deteriorated floor systems.

The floor planking was waterproofed by coal-tar pitch, carefully filling all the joints and covering the top surface. Crowning of the roadway was obtained by filler plates between the stringers and floor-beams. The planks immediately above transverse floor-beams were toenailed to the adjacent planks, the latter being bolted as shown. To prevent conditions so often met in wood-block flooring, where humps and hollows are seen, the creosoted wood blocks were laid directly upon a hot coating of coal-tar pitch applied to the top surface of the floor planks, which had been previously brought to a true surface.

The openings between the paving blocks, 3 in. deep, were filled with coal-tar pitch to a height of 2 in. above the bottom of the block, and the remaining 1 in. was filled with sand, with a view to preventing the pitch from coming out of the openings by expansion. As seen in the plan, drainage was provided by scuppers, details of which are also indicated, and by holes bored through the planking at points so as to take care of water that might work through the paving; this was

done to keep water away from the steelwork of the floor. It is stated that the roadway floor, after nearly three years' service, is now in first-class condition and shows a smooth surface. The method of attaching the wooden floor to the steelwork as shown increases greatly the lateral stiffness of the bridge, and assists in reducing vibration to a minimum.

Protection of Steelwork—In order to protect the steel stringers and the floor-beams, concrete was placed above the latter to fill completely the space between the steel and the bottom of the floor planking. Concrete was also placed around the bottom panel points and under the sidewalk, as indicated in the cross-section. This concrete, where necessary, was held in place by expanded metal reinforcement.

Owing to the fact that the bridge seats on piers and abutments were completely piled up with débris and trash around the end floor-beams and shoes, it was decided to incase completely the shoes and the transverse end floor-beams of the new steel floor; where necessary, expanded metal reinforcement was used. This is indicated in the drawings.

Lower Chords Open—Although this particular bridge was not badly affected by corrosion of the lower chord eyebars, mainly because these bars happened to be placed a considerable distance below the level of the sidewalk planking which extended over them, this is a prolific source of deterioration. Sidewalk planking is usually carried over the chords and around the web members with insufficient clearance spaces. One case is known where the lower chord bars were placed close to the sidewalk floor planking which rested upon the curb and also close against the curb timbers; a loss of 56% of cross-section was found in some of the bars.

In order to avoid possibility of such deterioration, the sidewalk planking was stopped outside of the trusses as shown, and a new intermediate hand railing was introduced, supported by cast-iron brackets on the vertical web members of the trusses. This leaves a completely clear open space around the eyebars for both the bottom chords and web diagonals, which are thus kept perfectly clean and always accessible.

Although these spans are nearly 200 ft. long, it was decided to replace the rusted end rollers by sliding plates, as indicated in one of the drawings. The space occupied by the old rollers was filled by two built-up steel bearing plates between which was placed a manganese bronze plate. Above and below the steel plates ½-in. plates took up any unevenness in the old masonry plates or the base plates of the pedestal shoes. The space indicated in the steel plates was provided to allow for the tongues in the old masonry and shoe plates. The end shoes were completely incased in concrete, with a single sliding paper joint at the level of the bronze plate.

All of the new steelwork received one shop coat of red-lead paint containing 20 lb. of lead to the gallon of oil, and, after being thoroughly cleaned, all exposed surfaces of the old ironwork received one good coat of the same paint. All of the exposed surfaces of the metal work below the floor level, and the web members of the trusses to a height about 3 ft. above the floor level, were finished with two additional coats of red-lead paint, tinted to a dark brown with lampblack. The remaining exposed surfaces of the trusses and bracing, as well as the outside hand railings, were finished with two additional coats of white-lead paint, tinted to a warm light gray to give a pleasing appearance and add to the visibility at night.

Port Kennedy Bridge—Another case of exactly similar deterioration of the floor system requiring entire replacement is the Port Kennedy bridge, also in Montgomery County, Pennsylvania. In this the longitudinal steel stringers were carried on brackets on the main floor-beams, the tops of the stringers being only about 1½ in. above the top flanges of the floor-beams. This space formed an ideal lodging place for dirt and caused corrosion of the steel. In this case, also, it was found that the stringers were too shallow for their length, and, instead of the 8-in. I-beams, 12-in. I-beams were substituted.

The Pottstown bridge was closed and the traffic detoured over another bridge during the repair operations, which gave the contractor uninterrupted opportunity to tear out the old work and place the new materials. With these repairs the bridge should give good service for a number of years, with practically no attention except painting.

The total cost of the replacement of the floor system and painting of the Pottstown bridge, including pavement concrete and all other work complete, was about $22,000. The design was made and the work supervised by S. P. Mitchell, consulting engineer, Philadelphia, Penn., and the work was done for Montgomery County, Pennsylvania, by the Pittsburgh Construction Co., Pittsburgh, Penn.

Deflection of Continuous Beams and Rigid Frames

Tabulated Factors Facilitate Computation of Maximum Deflection — Approximation for Unsymmetrical Loading

By F. E. Richart
Engineering Experiment Station, University of Illinois, Urbana

MAXIMUM deflections of continuous beams or rigidly connected frames, not ordinarily given in text or reference books, can be obtained from the following expressions for the deflections of a few common types of structures and loadings. They have been derived in terms of certain factors, which are tabulated, and may be found useful in facilitating rapid calculation.

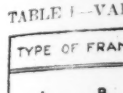
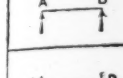
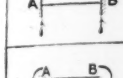
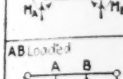
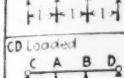
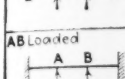
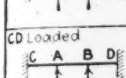
1. *Symmetrical Loading and Structure*—When the loading and structure are symmetrical about the vertical center line, the maximum deflection is at midspan and can be expressed quite simply. Let k be the ratio of the bending moment at the end of the loaded member to the moment which would exist there if the beam were completely fixed. The factor k may be termed the "degree of restraint" of the end of the member, varying from zero for a simple beam to unity for a fixed beam. Table I gives values of k for various cases of restraint which occur in continuous structures. These values have been found by use of the slope-deflection method, but they can be determined in other ways.

The deflection of the center of a beam may be expressed as

$$d = c\,\frac{P l^3}{EI},$$

in which c is a coefficient depending upon the value of k. Values of c may easily be determined by use of the theorem of area moments, from which it is

TABLE I—VALUES OF k AT END OF LOADED MEMBER AB

TYPE OF FRAME	VALUE OF K	TYPE OF FRAME	VALUE OF K
	0		$\frac{3}{2n+3}$
	1.0		$\frac{2}{n+2}$
	$k=\frac{M_A}{\text{Moment at end of fixed beam}}$		$\frac{2n+3}{(n+1)(n+3)}$
	$\frac{3}{5}$		$\frac{3n+6}{5n+6}$
	$\frac{6}{5}$		$\frac{6n+6}{5n+6}$
	$\frac{2}{3}$		$\frac{2n+4}{3n+4}$
	1.0		1.0

n = Ratio of $\frac{1}{l}$ for horizontal members to $\frac{1}{h}$ for vertical members

known that the deflection is equal to the statical moment of the M/EI diagram for one-half of the member, about the end. Table II gives values of c for various loadings.

As an example of the solution of a particular problem, consider the rectangular frame, Fig. 1, carrying the total uniform load P on the member AB. The deflection

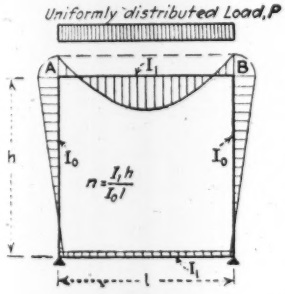


FIG. 1

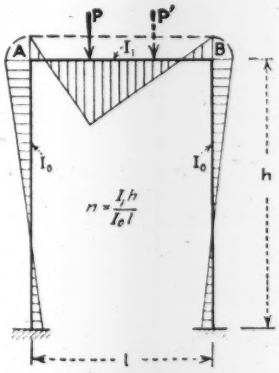


FIG. 3

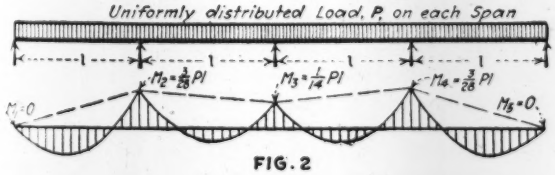


FIG. 2

FIGS. 1 TO 3. EXAMPLES, FACTOR METHOD FOR DEFLECTION

at the middle of the partially restrained member AB is desired. Assume the case in which the four sides of the frame are equal, or that the ratio I/l for horizontal members to I/h for vertical members, n, is unity. Hence, from Table I, $k = \frac{2}{3}$, and from Table II, $c = 5/768$. Hence, the deflection is $5Pl^3/768EI$, which is half the deflection of a simple beam and 2½ times that of a fixed beam similarly loaded.

2. *Symmetrical Loading, Unequal Restraints at the Two Ends*—In a continuous beam carrying a uniform load, for example, the moments at the two ends of any particular span are not generally equal. Therefore, the maximum deflection is not exactly at the middle of the span, but it can be shown that the midspan deflection is always very nearly equal to the maximum deflection.

The midspan deflection can be found by using the expressions of Table II, letting k equal the *average* values of the ratio of the actual moments to the fixed beam moments at the two ends.

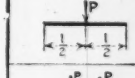
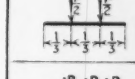
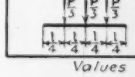
For example, in the continuous beam of Fig. 2, values of moments at each support have been determined, and the ratio of the moment at the support to the fixed beam moment for this loading is found to be zero at the first support, 9/7 at the second support and 6/7 at the middle support. Hence, the average degree of restraint k is 9/14 for the first span and 15/14 for the second span. The midspan deflection, from Table II, is

$$\frac{(5 - 4\,k)\,P\,l^3}{384\,EI},$$

which reduces to 17 $Pl^3/2688\,EI$ in the first span and $5Pl^3/2688\,EI$ in the second span.

As a matter of fact, the maximum deflection is at $0.440l$ in the first span and at $0.543l$ in the second span, and these deflections are 2.15% and 1.44%, re-

TABLE II—VALUES OF DEFLECTION

TYPE OF LOADING	VALUE OF C	TYPE OF LOADING	VALUE OF C
	$\frac{4-3k}{192}$		$\frac{5-4k}{384}$
	$\frac{23-18k}{1296}$		$\frac{32-25k}{1920}$
	$\frac{19-15k}{1152}$		$\frac{m}{48}\left[3-4m^2-3k(1-m)\right]$

Values of deflection coefficient "c" for various loadings

spectively, greater than those at the middle of the two spans.

3. *Unsymmetrical Loading, Symmetrical Structure*—The deflection due to a single load P unsymmetrically placed, Fig. 3, can be arrived at by adding a second equal load P' placed so that the two loads are equidistant from midspan. The deflection due to the two loads is found from Table II to be

$$d = \frac{2\,P\,l^3\,m}{48\,EI}\left[3 - 4\,m^2 - 3\,k\,(1 - m)\right].$$

Now removing the load P', the deflection at midspan due to the single load P is equal to one-half the deflection for the two loads, and is practically equal to the maximum deflection. The total deflection due to a number of loads will be found by adding the midspan deflections due to each load considered separately.

As an example, the deflection of the member AB, Fig. 3, due to the load P will be found. Suppose that $n = 2$, and $m = 1/3$. From Table I, k is $2/(n + 2)$ or $1/2$ for this frame, and the deflection at midspan,

$$d = \left[\frac{23 - 18k}{1296}\right]\frac{Pl^3}{EI} = \frac{7Pl^3}{648EI}$$

It is of interest to know that the maximum deflection of AB is at a distance of $0.438l$ from A and is 2% greater than that at midspan.

Groined Arches or Flat Roof for Concrete Reservoirs

Several Engineers and Builders Give Opinions as to Relative Economy and Safety, Based on Experience With Both Types Through a Number of Years

FOLLOWING the publication in *Engineering News-Record* of May 22, 1919, p. 1016, of the description of the Dayton reservoir, in which a saving was claimed in the substitution of a flat-slab concrete roof for the originally designed groined arch cover to a reservoir, some question arose as to the generality of such a claim. The subject has been controversial for some years; some engineers have maintained that the groined arch is the cheapest form of concrete reservoir cover; others have substituted with economy—and in some cases with claimed greater safety—a flat roof of either the girderless or beam-and-slab type. In order somewhat to crystallize opinions, a letter was addressed to several engineers and contractors experienced in such design and construction, asking for a statement on the subject. The answers so far received are printed below:

Allen Hazen, Consulting Engineer, New York—In one case in our experience, after the contract was let for reinforced vaulting we gave the contractors, who were one of the best known firms doing reinforced-concrete work, permission to substitute reinforced design for the groined arch. These contractors, after studying the matter to their full satisfaction, reported that they could not build a reinforced roof of any type that they knew about as cheaply as the groined arch, and they therefore built the groined arch as designed in preference to a reinforced roof. In Newton, Mass., bids were obtained on both plans for a covered reservoir, and the bids for the groined vaulting ran very much below the reinforced work, so the reservoir was actually built that way. In our studies, running through years, we have found that greatest economy in covers in the groined arch vaulting.

Centers for groined vaulting are as cheaply made, as easily moved forward, and can be used as many times as centers for slabs. Our cost records do not warrant the statement that the forms for the flat slab are cheaper. Taking it altogether, the groined roof, together with probably very much greater strength, has less concrete. The cost of the steel reinforcing is eliminated, the cost of placing is no greater, and the form cost is no greater. The reason that it is stronger and more economical is that all of the concrete is in compression, and that is the most advantageous way to use concrete.

L. C. Wason, President Aberthaw Construction Co., Boston, Mass.—About twenty years ago we were invited to bid upon groined arch and asked permission to make an alternative design in reinforced concrete, which permission was granted. After a very careful and thorough study we came to the conclusion that the groined arch was the cheaper of the two. Some five to ten years later, when we had more experience and thought that conditions might have changed, we made another study when the problem came up—with the same conclusion, that groined arch roofs are enough cheaper than reinforced concrete for storage reservoirs that there is no justification in using anything else.

My recollection is that the thickness of the groined arch was about 4 in. at the thinnest point and rather thicker at the haunches, and I believe that there was enough material in this design to allow for considerable carlessnesses and poor workmanship on the part of the contractor and yet give a strong enough structure to serve its purpose.

It is my opinion that a groined arch can be made satisfactory and plenty strong enough to do its work with no more concrete than is used in a reinforced design.

Nelson J. Bell, Engineer, Dayton, Ohio—My experience in this matter is limited to the Dayton reservoir, which was described in *Engineering News-Record* of May 22, 1919. My connection with the job was as designing engineer for a contractor who was endeavoring to get the contract, and the problem was to make an alternate design cheap enough to get the award, and at the same time comply with the general requirements which were established by the consulting engineers.

The result we obtained was a structure which was five or six times as strong as the groined-arch design, and which cost some $10,000 less than the lowest bid received on the groined-arch design. The flat slab, which was finally built, was much stronger than ordinary building practice would dictate. If we had been allowed to design this slab as ordinary factory building slabs are designed, we could have cut the cost some $20,000 more.

However, the economies in the alternate design of the Dayton reservoir were not confined to the roof slab only, as we reduced the excavation and wall sections by sloping up the floor at the sides, maintaining the capacity of the reservoir by increasing its area.

I cannot conceive how groined arch centering can be made as cheaply as flat-slab centering, or that concrete can be poured in groined-arch construction as cheaply as flat slab. In Dayton the difference in cost of these two items was more than sufficient to pay for all of the extra reinforcing steel which was required in the flat-slab design.

It is, therefore, my opinion that on a basis of equal strength groined arches will always cost more than flat slab.

J. R. McClintock, Fuller & McClintock, Engineers, New York—There is little question that the groined type of arch for reservoir roofs is the cheapest form of concrete cover. Under favorable conditions, also, the groined arch, properly designed, is capable of carrying any reasonable loads which are distributed with fair uniformity. Nevertheless, we prefer, under certain conditions, to use the roofs of reinforced concrete, usually of the slab-and-girder type.

The stresses in the groined arch cannot, of course, be accurately determined, but approximate methods are available, based partly upon theory and partly upon lessons learned from existing structures, which are close enough for all practical purposes, provided the arches remain substantially in the shape and condition in which they were constructed. Groined arches are, however, in many cases affected to a considerable extent by expansion and contraction or shrinkage of the concrete and by settlement of the foundations. If the area covered by the arches is relatively small, the effect of expansion and contraction may not be sufficient to

effect the arch action; but it is true that in most groined-arch structures some of the arches open at the crown, thus destroying action altogether along certain lines. Even then the arches seldom fail, but act as cantilevers over the piers. Clearly, however, the theory upon which such arches were designed does not apply in these cases.

Expansion and contraction movements are also taken up by the barrel arches along the outside walls of the reservoir, resulting in cracks in these barrel arches and the possibility of failure. If any settlement of foundations occurs, the stresses in the arches are affected and will not correspond with those assumed in the design.

Complete failures of groined arches have usually only occurred during the construction and as a result of unequal loading or failure to provide adequately for the thrust in the uncompleted series. Cracks, however, generally do occur in completed structures, and may be sufficiently serious to necessitate the supporting of some part of the roof at the crack, or they may interfere with the use for which the structure was designed. A case of the latter kind is that of the sand filters at Wilmington, Del., where the groined arches supporting the filters opened at the crown to such an extent that expensive repairs were necessary in order to prevent the filtered water from passing through the cracks into the filtered water basin beneath instead of passing through the piping. It has been our practice in a number of cases where groined arches were used to support filters, substantially to reinforce such arches to prevent expansion and contraction cracks.

As between the slab-and-beam type and the girderless type, we prefer the former on account of the possibility of more accurate analyses of the stresses and on account of greater safety where there are openings in the roof. It is possible, however, that the girderless type may be slightly cheaper. In the Rodney St. reservoir at Wilmington, Del., we made use of the beam-and-slab construction on the grounds of greater safety. This reservoir roof has on top of it a skating rink which is used by large numbers of children, so that the hazard in event of failure of the roof would be very large. Also the fact that the asphalt skating rink is directly on the concrete slab means that the structure would be subject to great variation of temperature.

Charles B. Burdick of Alvord & Burdick, Engineers, Chicago.—For about fifteen years we have been using reinforced-concrete reservoir construction, and where roofs were required—as they usually are—we have employed the flat-slab design exclusively, usually covered with earth. The basins included a large number of water reservoirs and sedimentation basins not exceeding 5,000,000-gal. capacity.

For structures such as these we have not been able to figure any advantage in the groined-arch type of construction. So far as lower cost is concerned and in ordinary circumstances, it is our opinion that the completely reinforced reservoir is a much better and more dependable structure.

In the above conclusion it should be particularly noted that we take into consideration not only the roof but the remainder of the reservoir structure, which is largely influenced by the type of roof, particularly the groined arch, and our conclusions have been somewhat influenced by the gradual tendency, as a result of our experience, to get away from nonreinforced concrete entirely, and thus to avoid cracks which are most troublesome in structures to contain water. It has been our tendency in recent designs, referring to reservoirs with vertical sides, to place no dependence upon the exterior earth pressure as resisting the pressure of the water, but to transmit the water pressures through the sides to the roof and floor, thus making the reservoir entirely self-contained and avoiding unequal settlement or large cracks. It is our practice to reinforce amply for temperature in both the floor and roof, and as we have worked out our designs the comparatively small side-wall forces are carried with but small addition to the roof and floor bars that would be needed anyway to insure freedom from cracking.

It must not be understood that we have, in writing the above, made an attempt to prove the superiority of the flat-slab construction in general as compared with the groined arch. We merely stae a conclusion of observations upon our own work. I have no doubt that there are situations where the groined arch can be profitably employed, and some important works designed by very capable engineers would indicate this.

C. A. P. Turner, Consulting Engineer, Minneapolis, Minn.—In all cases where we have bid on reinforced-concrete reservoir roofs the flat-slab design has proved more economical than the groined arch. There is, too, the added advantage that flat slabs are not subjected to the uncertainty of the groined arch under unbalanced loads. This uncertainty has caused the collapse of many groined arches and renders their construction, in the writer's judgment, more or less a hazard.

John M. Rice, Morris Knowles, Incorporated, Engineers, Pittsburgh, Penn.—We have had occasion to make computations regarding the comparative cost and advantages of groined-arch and flat-slab roofs for reservoirs, and after making such studies have always come to the conclusion that in all except exceptional cases the groined arch is preferable because of its cheaper cost of production.

In considering the covers to the Pittsburgh filters and the filtered-water reservoir, careful studies were made of the cost of reinforced-concrete flat-slab and beam roofs and groined-arch roofs, taking into account the experience and detailed knowledge of the cost of the groined-arch system which had been previously used in Philadelphia, Albany and Washington filter plants. The conclusion was reached that the groined-arch system was less costly than the other. In this instance the area of the filters is 56 acres and that of the filtered-water reservoir a little over six acres.

In 1907 it became necessary to increase the filter area at Lawrence, Mass., and there again similar studies of cost were made, resulting in the same conclusions. In connection with this plant, it may be of interest to note that one of the instances of failure of groined-arch roofs occurred there in the spring of 1907, when a considerable portion of the unfinished roof fell, overturning several of the piers. A report on the collapse of this roof was made by Sanford E. Thompson and may be found in the *Journal of the New England Water Works Association* for 1908. In this account, however, he does not blame the failure on the design, but says it was probably due to three causes:

First, the unbalanced thrust in the arches, due to the fact that the roof was incomplete and that the centers had been removed.

Second, the frozen concrete caused by low temperature immediately after its placing.

Third, improper screening of the aggregate and dirty gravel.

In our design of a small slow sand filter plant made during the past year, our studies again led to the conclusion that the groined-arch type of cover for filters was preferable to the flat-slab roof of the girderless type.

We would not like, however, to place ourselves on record as saying that the groined-arch type of cover for reservoirs and filters is preferable in all cases, since each design must be made a separate study, and the availability and prices of the materials making up the different types of roof will of course be the determining factors. The increasing use of the girderless system of roof is also cutting down the economical superiority of the groined-arch type, due to introduction of less expensive methods of construction. As the art of proportioning concrete so as to increase its strength is improved, the reinforced-concrete type of roof may possibly be constructed more cheaply than at present. Unless the methods of determining the stresses in the groined arch are greatly improved, the economical superiority of the groined-arch type of roof will be difficult to prove, owing to the uncertainty of the safety factor.

However, enough examples now exist in practice to show that the groined arch as now designed will carry the loads ordinarily imposed and the extra loads sometimes carried during construction. Where the loads can be decreased, as for instance by the use of a smaller depth of earth cover or its entire omission, then the advantage may be with the reinforced-concrete designs; as it will not be possible for practical construction reasons to reduce greatly the dimensions of the groined arch.

Two Home-Made Bridges in a Catskill Village

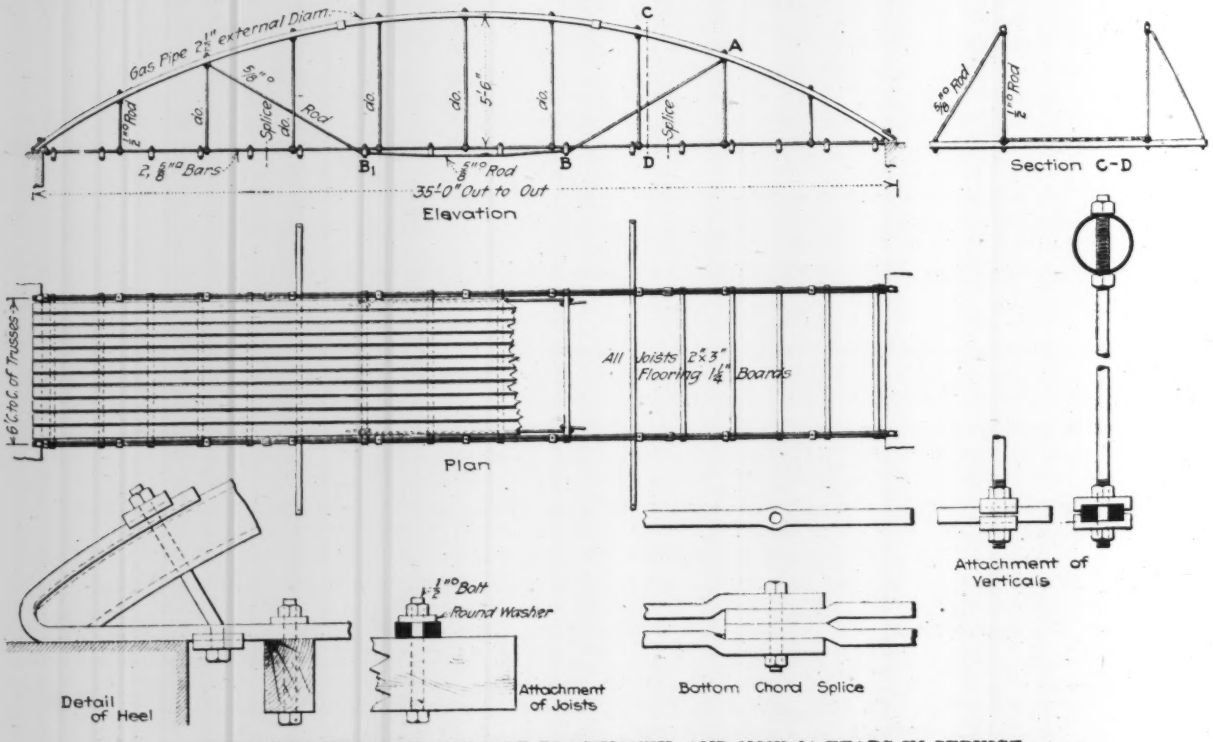
Blacksmith's Gaspipe Arch Bridge Nearing Half Century of Service—Truss Rod Distributes Unsymmetrical Loads

By R. Fleming
American Bridge Company, New York

THE village of Windham, in the heart of the Catskill Mountains, New York State, has within its confines two sidewalk bridges which are somewhat unusual. They were both built by Henry Bagley, a blacksmith of the village. According to the best information available the one was erected about 1875 and its neighbor about 1885. The accompanying sketches were made from the later bridge. Note the diagonal from the top-chord joint A. It runs into the wooden joist at B. A similar rod extends from B to B_1. These rods act as ties in transmitting stress due to moving loads. No lateral bracing is used in the plane of the bottom chord.

The older bridge is of the same dimensions as the later one and differs from it in only a few particulars. The bottom chord is continuous. Evidently the stock of square bars for the bottom chord gave out, for a piece of rod iron 10 or 12 ft. long is welded into the middle of one bar.

Decided vibration, both vertically and laterally, is noted every time the bridges are crossed. The village official under whose authority the later bridge was built said the school-children have a habit of jumping up and down to feel the bridges shake, and he expressed an opinion that some time there would be an accident. The writer concurred in this opinion, but when bridges have stood up more than thirty and forty years in spite of theory, what can be said?



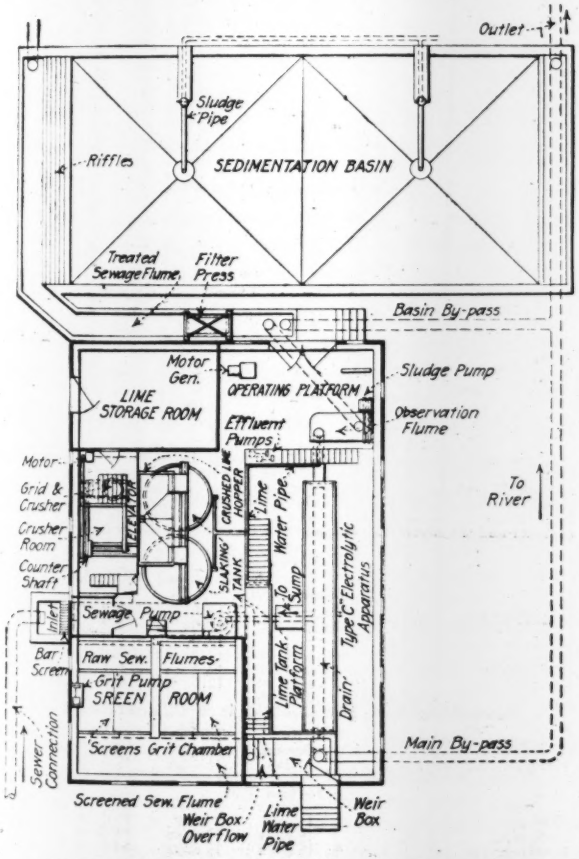
PUBLIC FOOTBRIDGE BUILT BY BLACKSMITH, AND NOW 34 YEARS IN SERVICE

Another bridge ten years older, but of practically the same construction, is near this one. There is no lateral bracing. School-children jump up and down on the bridges to make them shake

Tests of Lime-Electrolytic-Agitation Sewage-Treatment Process at Easton, Pennsylvania

Landreth "Direct-Oxidation" System Studied by Engineering Division of Pennsylvania State Department of Health and for Committee of the Franklin Institute

COARSE bar screens, fine plate screens, a grit chamber, lime treatment at the rate of 3720 lb. per 1,000,000 gal. simultaneously with electrolysis and with mechanical agitation by 2068 paddles running between the electrode plates, and finally 4½ hours of sedimentation, produced a satisfactory effluent during an 8- and a 24-hour run of a 1,000,000-gal. Landreth "direct-oxidation" sewage-treatment plant built for demonstration purposes at Easton, Penn., according to an official report recently made public. The plant was operated by the promoter. The tests were conducted and the report was made by the engineering division of the Pensylvania State Department of Health. Where a high constant degree of bacterial reduction is required, disinfection of the cell effluent "would be on the side of safety," the report states. The cost of operating the plant during these tests (at much less than full nominal capacity and with what the promotor states is an excessive rate of lime application, although the rate was set by himself) is figured in the report at $66 per 1,000,000 gal. This includes pumping the sewage to an elevation of 14½ ft., but makes no allowance for sludge disposal. If the same plant were operated at its full 1,000,000-gal. rated capacity the operating cost would be $39.08 per 1,000,000 gal., with sludge disposal probably $7.50 additional. Capital charges are not included in either the $66 or the $37.08 estimate. The cost of installing a plant of this type "should not be excessive," the report states, "but the cost of operation would appear to be higher than for other methods of sewage treatment in general use to produce an equal quality of effluent." The lime-electrolytic-paddle apparatus should be in duplicate and, since the plates would undoubtedly have to be renewed from time to time, a "type of cell should be adopted which admits of such renewals in place and at a minimum cost of labor."



GENERAL LAYOUT OF DEMONSTRATION SEWAGE-TREATMENT PLANT AT EASTON

Investigators for the Franklin Institute, reporting on later, independent and uncorrelated tests made in five runs of 3 to 14.5 hours each, totaling 35.5 hours, also report a satisfactory effluent. In addition, they present test data and conclusions designed to show that the lime-electrolytic treatment gives a much better effluent than either lime or electrolysis alone. These conclusions are based on average results of the five runs aggregating 35.5 hours, compared with a one-hour run with lime alone and a one-hour run with electrolysis alone, made on the following day. For a 2,000,000-gal. and a 10,000,000-gal. plant, the Franklin Institute report estimates the cost of treatment at $15.98 and $9.28 per 1,000,000 gal., but this appears to include nothing except lime, electrolysis and paddle treatment. The nearest comparable figure in the report by the State Department of Health is $36.06 for operating the Easton plant at its full rated capacity of 1,000,000 gal. a day. The Franklin Institute report states that, owing to the necessity of housing in an electrolytic plant and of providing skilled labor, the Landreth process is not "economical if the population tributary to the plant is very small," unless it is possible to put the sewage-works, a water-pumping plant and an electric lighting plant under one roof, thus reducing the cost of housing and of operation. In dealing with chemical and bacterial results, as with costs, the Franklin Institute report omits all consideration of preparatory as well as of final treatment, although the fine screens and the settling basins are included in the description of the plant.

This article will take up in some detail both reports. For convenience, the tests made by the engineering division of the Pennsylvania State Department of Health will generally be called the Pennsylvania tests and those of the Franklin Institute the Franklin tests.

The Pennsylvania Tests

The experimental plant was installed at the expense of C. P. Landreth, Philadelphia, under permission granted by the city. It was put in operation shortly after May 1, 1918, but from then until the date of the Pennsylvania tests it appears to have been run a total of only about 18 days. The Pennsylvania tests consisted of an eight-hour run on Dec. 4, 1918, and a 24-hour run Dec. 6-7, 1918. During these tests the operation of the plant was entirely in the hands of the patentee. Observations were made under the direc-

tion of C. A. Emerson, Jr., chief engineer, State Department of Health, by A. L. Reeder and R. B. Styer, assistant engineers, W. R. Crall and J. L. Sullivan, inspectors.

The fresh, rather dilute domestic sewage is first passed through a coarse bar screen, then lifted 14½ ft. by a centrifugal pump to a flume from which the flow is by gravity through the rest of the plant. From the flume the sewage discharges onto a flat plate screen with closely spaced ⅛-in. round holes, from which it drops into a hopper-bottomed grit chamber. The cell effluent passes through a flume, over concentric riffles and into two settling reservoirs having a combined holding capacity of 88,740 gal. This gives a detention period of about 2¼ hours when the tanks are free from sludge and the flow is at the rate of 1,000,000 gal. a day. Provision is made for drawing the sludge from the bottom of the tanks to small sludge-drying beds. A sheet-iron building 35½ x 48½ ft. in plan houses the plant, except the cell-effluent flume, the settling reservoirs and the sludge beds. Nine electric motors and one motor generator are provided, as follows:

	No.	Hp.
For pumping raw sewage	1	7½
For lime treatment, lime crusher	1	5
Lime pump	2	1
Feeding and agitation	2	1
For electrolytic cell, paddles	1	3
Electrolysis	1	5-kw. generator set
For grit and sludge, grit pump	1	2
Sludge pump	1	1

The fine screen and grit chamber are in duplicate, only one side being used at a time.

The grit chamber effluent discharges into a second flume, passes over a 3-ft. weir, is treated with lime in suspension, and then goes to the electrolytic cell.

The electrolytic apparatus is placed in a closed wooden tank, 3 ft. wide, 2¾ ft. high and 27½ ft. long (outside), provided with two 2-in. wrought-iron vent pipes at the top and clean-outs in the bottom. The electrodes consist of 22 banks of plates, 11 above and 11 below. In each bank there are 48 steel plates, 16 in. long, 10 in. high and $\frac{3}{16}$ in. thick, placed parallel to the sides of the tank and spaced ⅜ in. apart. In each space between plates there are two straight paddles of Bakelite, or 2068 in all, driven at a speed of 20 revotions per minute.

At the normal, or 1,000,000-gal., rate of the plant, the sewage would pass through the cell in 70 sec., but would be in contact with the electrodes only 17.4 sec., as their combined length is only 14⅜ ft. The theoretical velocity of the sewage as it passes between the plates is 0.84 ft. per second. The patentee claims that in his process lime treatment prior to electrolytic action is essential "to insure positive alkalinity" and prevent "attack of the electrodes." The agitation by the paddles revolving between the electrodes, the report states, "in addition to its well-known effect in inducing precipitation, brings the sewage into intimate contact with the products of electrolysis," so that "chemical reaction is thereby stimulated while the gases (oxygen and hydrogen) are in their nascent state and before they have an opportunity to escape." A further effect of the paddles is "to mechanically clear the plates and prevent polarization." Such polarization as does occur from time to time "is overcome by a reversal of the polarity which quickly decreases the necessary voltage and increases the current." For satisfactory cell operation, an alkalinity of 30 p.p.m. is said to be necessary. This was always exceeded during the test.

Table I gives a summary of the results of the test:

TABLE I. RESULTS OF SEWAGE-WORKS TESTS AT EASTON, PA., BY PENNSYLVANIA DEPARTMENT OF HEALTH

Power Consumption	8-Hour Test	24-Hour Test
Lights and electric heaters	11 kw.-hours	47 kw.-hours
Pump motor	30 kw.-hours	90 kw.-hours
All other power	50 kw.-hours	130 kw.-hours
Total	91 kw.-hours	267 kw.-hours
Total water consumption (this includes toilet, lavatory and the stuffing boxes of the centrifugal pump)	66 cu.ft.	166 cu.ft.
Quantity of lime		1,712 lb.
CaO content		61.52%
Average voltage for electrolysis	56.3	57.5
Average current for electrolysis, amperes	37.8	33.8
Average wattage for electrolysis	2,125	1,944
Average wattage for paddles	1,388	1,355
Sewage flow, in gallons per 24 hours	482,700	460,000
Average sewage flow, in gallons per hour	20,110	19,190
Electrolytic hydrogen liberated, in grams per hour	31.04	27.82
Electrolytic oxygen liberated, in grams per hour	247.73	222.03
Ratio of electrolytic hydrogen to sewage by weight	0.4 p.p.m.	0.4 p.p.m.
Ratio of electrolytic oxygen to sewage by weight	3.2 p.p.m.	3.0 p.p.m.

Bacteriological Results: Bacteria per Cubic Centimeter; Eight-Hour Test

	Time	Raw Sewage	Screened Sewage	Cell Effluent	Basin Effluent
Total bacteria	2:30 p.m.	800,000	200,000	38,000	2,000
B. coli	2:30 p.m.	36,000	24,000	0	0
24-Hour Test					
Dec. 6-7					
Total bacteria	8:00 a.m.	920,000	680,000	24,000	65
B. coli	8:00 a.m.	100,000	20,000	0	0
Total bacteria	4:00 p.m.	240,000	216,000	2,500	1,500
B. coli	4:00 p.m.	12,000	50,000	0	0
Total bacteria	12 midnight	48,000	16,000	190,000	18,000
B. coli	12 midnight	15,000	18,000	0	0
Total bacteria	8:00 a.m.	1,200,000	1,800,000	24,000	30,000
B. coli	8:00 a.m.	45,000	30,000	0	0

Physical and Chemical Results, Eight-Hour Test

	Time	Screened Sewage	Basin Effluent
Total alkalinity	12:15 p.m.	106	193
Total alkalinity	4:00 p.m.	103	326
24-Hour Test			
Dec. 6			
Total alkalinity	8:00 a.m.	98	380
Total alkalinity	12:00 m.	89	276
Total alkalinity	4:00 p.m.	88	252
Total alkalinity	8:00 p.m.	98	282
Dec. 7			
Total alkalinity	12:00 midnight	85	288
Total alkalinity	4:00 a.m.	86	341

Screenings removed, 24-Hour Test

Bar screen	117 lb.	Plate screen	379.76

Results Expressed in Parts per Million, 24-Hour Test

	Raw Sewage	Screened Sewage	Cell Effluent	Basin Effluent
Total solids	217	248	608	640
Volatile solids	114	140	196	94
Fixed solids	103	108	412	546
Suspended solids	74	69	215	26
Nitrogen as				
Organic	34.5	34.2	21.5	21.6
Free ammonia	11.3	11.5	9.2	9.3
Nitrites	0.045	0.05	0.06	0.06
Nitrates	0.46	0.45	0.93	0.90
Oxygen consumed	53	52	44	44

Raw sewage samples were collected from the discharge pipe of the pump after sewage had passed the bar screen. Screened sewage samples were collected after the sewage had passed the bar screen, the pump, the plate screen and the grit chamber. The samples of the cell effluent were taken from the observation flume. This sewage had passed the bar screen, the pump, the plate screen, the grit chamber and the electrolytic cell, and had also received the lime treatment.

Dissolved Oxygen

	Time	Temperature, Degrees C.	Content, p.p.m.	Saturation Per cent
Cell influent	10 a.m.	12.0	3.7	34
Cell effluent	10 a.m.	11.0	5.2	47
Cell influent	6 p.m.	12.0	6.8	63
Cell effluent	6 p.m.	11.0	7.0	65
Cell influent	2 a.m.	12.5	6.7	62
Cell effluent	2 a.m.	12.5	8.3	77

Putrescibility: Using Methylene Blue at 20° C., Eight-Hour Test

	Raw Sewage	Screened Sewage	Cell Effluent	Basin Effluent
1:45 p.m.	1 day	1½ days	4½ days	9½ days
24-Hour Test				
Dec. 6				
9:00 a.m.	1 day	1 day	14 days	14 days
3:00 p.m.	1½ days	1½ days	14 days	14 days
11:00 p.m.	1½ days	1½ days	14 days	14 days
Dec. 7				
7:00 a.m.	1½ days	1½ days	14 days	14 days

Putrescibility of Sludge From Res tiling Basins

	100% Sludge	75% Sludge 25% River Water	50% Sludge 50% River Wat.r	25% Sludge 75% River Water	100% River Water
Standard quantity methylene blue solution	3 hrs.	3 hrs.	3 hrs.	3 hrs.	14 days
Three times st n'ard quantity methyl ne blue solution	3 days	14 days	1 day	3 days	14 days

The entries signify the period during which the samples retained a blue color excepting in cases where the entry reads 14 days, which signifies that the color was still present when the samples were thrown away at the end of the 14-day period.

At the end of the test an examination of the cell plates showed that after removal of the coating from the plates the latter were bright and apparently in good condition. On analysis the coating was found to contain 1.73% of iron. The report states, "there was no evidence during the test that under operating conditions there is a rapid deterioration of the plates to form a chemical coagulant, which was purposely intended in the early processes for the electric treatment of sewage."

A rough indication of the cost of operating a 1,000,000-gal. plant under Easton conditions, with the dosage there used, but which is stated by the owner of the plant to be greatly in excess of that needed for satisfactory results, is given in Table II.

TABLE II. ESTIMATED COST OF OPERATING 1,000,000-GALLON SEWAGE WORKS LIKE THAT AT EASTON

Without Pumpage	
Hydrated lime, 3720 lbs. at $6.75 a ton	$12.56
Water, 20 cu.ft. at $0.003 per cubic foot	.06
Electric power, 185.5 kw.h., at $0.0226	4.19
Electric lights, 6¼ kw.h., at $0.0805	.50
Heating	1.25
Labor and superintendence	15.00
Electrode renewals	1.00
Maintenance and repairs	1.50
	$36.06
Add for Pumpage	
Electric power, 117.7 kw.h., at $0.0226	2.66
Water, 120 cu.ft., at $0.003	.36
Total	$39.08

The Franklin Tests

The Franklin Institute tests were made Feb. 18-21, 1919. They fall into two parts: (1) Six runs of 3 to 14.5 hours each, totaling 35.5 hours, made Feb. 18-20, "operated in the manner recommended by the inventor"; and (2) two runs of one hour each Feb. 21, prompted by assertions "that the efficiency of the process was due primarily to the action of the lime" and that electricity played "but a minor part."

The report on the Franklin tests is published in the *Journal of the Franklin Institute* for August, 1919, as a "Communication" by Henry Jermain Maude Creighton, Department of Chemistry, Swarthmore College, and Benjamin Franklin, civil engineer, members of the institute. A footnote states that "this paper embodies the results of an investigation of the Landreth direct-oxidation process by the Committee of Science and the Arts of the Franklin Institute." Elsewhere in the *Journal* is an official notice that the committee just named "proposes to award the Howard N. Potts gold medal to Clarence P. Landreth, Philadelphia, Penn., for his electrolytic sewage process."

The Franklin report describes the experimental plant in much the same terms as the Pennsylvania report, but gives some additional details. The most notable of these are that the fine screen is cleaned by brushes "arranged on a traveler"; that the total positive and negative electrode area in electrolysis apparatus is 124,287 sq.in.; that each steel plate composing the electrodes weighs 8.33 lb. and all of them together 8797 lb.; and that the assertion of the inventor that "the total amount of iron removed by the current amounts to 1.41 lb. in 24 hours, and is not in any way influenced by the volume of sewage treated" has been "substantiated by tests made by the writers"—from which it is computed that the electrodes would last 11.4 years, assuming that two-thirds of the metal "can pass into solution without rendering them useless."

During the Franklin tests "the plant was operated under the direction and constant supervision of one of the writers (which one is not stated) and his two assistants, O. R. Quale and J. D. Ballard." Most of the chemical analyses noted were made at the plant immediately on the taking of the composite samples. Albuminoid-ammonia and free-ammonia determinations were made by James De Long at Lafayette College, Easton (close at hand). Determinations of suspended matter and dissolved oxygen after five days were made at the Swarthmore chemical laboratories. Bacterial counts were entrusted to Dr. E. R. St. John, Philadelphia.

Unlike the Pennsylvania tests, those made for the Franklin Institute did not show the progressive results of (1) fine screening; (2) the combination of lime-electrolytic treatment and mechanical agitation, and (3) sedimentation. In the Pennsylvania tests the "raw sewage" had passed the bar screens and the centrifugal pump, while in the Franklin tests the "raw sewage" appears to have been made up of some samples collected after fine screening and of others after they passed through both the fine screens and the grit chamber. The collection of raw and treated samples was timed in accordance with observations of the time required for dyestuffs to pass in the sewage between the sampling points.

As to the rate of lime dosing in the Franklin tests, the only information given in the report is that "the hydrated lime was fed into the mixing vat at the rate of 856 lb. per 24 hours, or an equivalent of 670 lb. 90% CaO lump lime. The milk of lime so formed was added to the raw sewage at the spillway weir at the rate of 30 gal. per minute." Analysis showed the lime used to contain 71.36% of CaO.

A summary of the results of the first or main tests is given in Table III. The "power consumed" appears to include only that used for electrolysis, for mixing and feeding the lime (including pumping effluent to mix the lime) and that for driving the paddles. In the Pennsylvania report all the power used at the plant is taken into account. This fact should be remembered in considering the cost estimates given in Table VI.

The second test, made to show whether there is any special efficacy in combining lime and electrolytic treatment, was confined to two 1-hour runs, because "the inventor was of the opinion that the electrode would be damaged by allowing the lime-containing sewage to flow through it in the absence of the electric current, or by operating it with the electricity in the absence of lime, for periods longer than one hour." This test, therefore, consisted of treating sewage with lime for one hour and (separate test) with electrolysis for one hour, mechanical agitation by the paddles being maintained in each case. The report does not say whether the sewage thus treated had been passed through both the fine screens and the grit chamber, but the presumption is that it had. Table IV shows results of this test.

TABLE III. FRANKLIN INSTITUTE TESTS OF SEWAGE-TREATMENT PLANT AT EASTON

R, denotes raw sewage samples; E, effluent. (The tests are designed to show the effect of lime, electrolytic and paddle treatment, only.—Editor)

No. of Composite Sample		1	2	3	4	5	6	7	8	Average	Change P.p.m.	Change Per Cent
Chlorine, p.p.m.	R	55.5	65.6	64.6	60.5	70.3	64.5	56.5	58.1	61.9		
	E	63.0	77.6	65.2	44.6	60.3	61.8	64.8	67.9	63.1	+ 1.2	+ 1.9
Nitrogen as—												
Nitrite, p.p.m.	R	0.009	0.025	0.030	0.035	0.025	0.019	0.033	0.028	0.024		
	E	0.028	0.043	0.036	0.050	0.030	0.028	0.023	0.040	0.038	+ 0.014	+ 58.3
Nitrate, p.p.m.	R	0.62	0.52	0.50	0.46	0.75	0.67	0.50	0.41	0.55		
	E	0.77	0.64	0.60	0.50	0.63	0.85	0.83	0.63	0.68	+ 0.13	+ 23.6
Free Ammonia, p.p.m.	R	17.2			17.0		17.8	19.8		18.0		
	E	15.6			13.9		14.4	14.8		14.7	— 3.3	—18.3
Albuminoid NH_3, p.p.m.	R	27.9			32.2		29.3	29.6		29.8		
	E	26.3			28.1		25.2	25.3		26.2	— 3.6	—12.1
Required oxygen, p.p.m.	R	51.4	71.2	65.8	61.9	74.9	64.5	59.0	59.5	63.5		
	E	43.0	54.1	58.6	43.6	55.4	51.2	52.0	46.2	50.5	—13.0	—20.5
Dissolved Oxygen—												
Determined immediately, p.p.m.	R	3.88	3.90	(6.55)	4.26	5.09	5.22	3.98	4.14	4.35		
	E	7.39	5.92	5.76	5.76	6.40	6.20	5.14	6.22	6.13	+ 1.78	+ 40.9
Determined after 5 days (10-15), p.p.m.	R	0.21	0.19	0.26	0.15	0.22	0.28	0.09	0.05	0.18	Absorption of oxygen on standing: in p.p.m. R=4.17, E=0.77; in % R=95.9, E=12.6	
	E	6.70	5.64	5.57	4.11	6.14	5.75	4.06	4.98	5.36		
Suspended solids, p.p.m.	E	256	268	169	293	271	193	251	182	235		
Temperature, degrees C.	R	7.4	7.5	7.5	7.7	7.9	7.9	8.9	9.1	8.0		
	E	8.1	8.3	8.4	8.6	8.8	8.8	9.7	9.9	8.8		
Bacteria—												
Total count per c.c., at 37°	R	215,000	155,000	250,000	312,000	475,000	425,000	527,000	603,000	370,000		
	E	28,000	6,000	27,400	25,000	37,000	20,300	32,300	37,300	26,800	—343,200	—92.7
Total count per c.c., at 20°	R	500,000	455,000	625,000	530,000	550,000	757,000	1,017,000	1,533,000	746,000		
	E	82,000	40,000	42,000	91,000	62,000	47,000	47,000	51,000	58,000	—688,000	—92.2
B. coli per c.c.	R	100,000	100,000	55,000	100,000	55,000	70,000	100,000	40,000	78,000		
	E	<10	<10	<10	250	<10	<10	670	0	120	— 77,880	—99.85
Period in hours		4.5	5	5	5	5	3	5	3			
No. half-hour samples in composite		9	10	10	10	10	6	10	6			
Average flow of sewage in 1000 gal per 24 hr.		543	446	358	468	481	388	532	496	464		
Power consumed, kw. hours		29	26	29	28	33	21	33	24		213 kw.-hr. for 686,000 gals.	
Kw.-hr. per hour		6.4	5.2	5.8	5.6	6.6	7.0	6.6	8.0	6.4		
Kw.-hr. per 1000 gal. sewage		0.29	0.28	0.39	0.29	0.33	0.43	0.29	0.38	0.335		

TABLE IV. RESULTS WITH LIME TREATMENT ONLY AND WITH ELECTROLYTIC TREATMENT ONLY; PADDLES USED IN EACH CASE

		Lime Treatment Only			Electrical Treatment Only		
		P.p.m.	Change, P.p.m.	Change, Per Cent.	P.p.m.	Change, P.p.m.	Change Per Cent
Chlorine	R	67.7			70.8		
	E	80.0	+12.3	+18.2	72.4	+1.6	+ 2.2
Nitrogen as—							
Nitrite	R	0.050			0.050		
	E	0.045	— 0.005	—10.0	0.040	—0.01	—20.0
Nitrate	R	0.62			0.75		
	E	0.625	+ 0.005	+ 0.8	0.60	—0.15	—20.0
Free NH_3	R	15.6			13.5		
	E	15.8	+ 0.2	+ 1.3	14.4	+0.9	+ 6.6
Albuminoid NH_3	R	23.8			22.2		
	E	23.4	— 0.4	— 1.7	21.7	—0.5	— 2.3
Required oxygen	R	84.6			64.5		
	E	76.9	— 7.7	— 8.9	58.0	—6.5	—10.0
Dissolved oxygen—							
Determined immediately	R	4.88			4.01		
	E	3.95	— 0.93	—19.1	5.62	+1.61	+40.1
Determined at end of 5 days	R	0.03	Absorption of oxygen on standing: in p.p.m. R=4.85, E=3.82; in % R=99.4, E=96.7		0.08	Absorption of oxygen on standing: in p.p.m. R=3.93, E=5.17; in % R=98.0, E=92.0	
	E	0.03			0.45		
Bacteria*							
Total count per c.c., at 37° C.	R	1,180,000			437,000		
	E	453,000		—82.4	272,000		—37.8
Total count per c.c., at 20° C.	R	1,192,000			908,000		
	E	118,000		—90.1	273,000		—70.0
B. coli per c.c.	R	100,000			55,000		
	E	3,700		—92.3	10,000		—81.80

*Bacteria values are the average of six samples taken every 10 minutes during an hour.

To compare the two methods of partial treatment with the full treatment, the "changes," expressed as percentages, between raw and partly treated sewage effected in the one-hour tests summarized in Table IV are contrasted with the averages of the "changes" shown by the complete process in the five runs, totaling 35.5 hours, made on the three previous days, the whole composing Table V.

Variations in the strength of the sewage passing through the plant when the three sets of tests compared in Table V were made are shown by the analyses of raw-sewage samples given in Tables III and IV.

The conclusions drawn from Table V by the authors of the Franklin Institute report are that the electrolytic-lime treatment produces a higher degree of oxidation and of bacterial removal than either lime treatment or electrical treatment alone.

In passing, the authors remark that the effluent produced by the electrolytic-lime treatment may be still further improved by final sedimentation, which would

TABLE V. CHANGES PRODUCED IN LANDRETH APPARATUS OPERATED AS STATED

	Lime and Electricity		Lime Alone		Electricity Alone	
	p.p.m.	Per cent	p.p.m.	Per cent	p.p.m.	Per cent
Chlorine	+ 1.2	+ 1.9	+12.3	+18.2	+1.6	+ 2.2
Nitrite	+ 0.014	+58.3	— 0.005	—10.0	—0.01	—20.0
Nitrate	+ 0.13	+23.6	+ 0.005	+ 0.8	—0.15	—20.0
Free ammonia	— 3.3	—18.3	+ 0.2	+ 1.3	+0.9	+ 6.6
Album. NH_3	— 3.6	—12.1	— 0.4	— 1.7	—0.5	— 2.3
Required oxygen	—13.0	—20.5	— 7.7	— 8.9	—6.5	—10.0
Dissolved O_2	+ 1.78	+40.9	— 0.93	—19.1	+1.61	+40.1
Dissolved. R = O_2 absorbed in 5 days. E =	4.17 0.77	95.9 12.6	4.85 3.82	99.4 96.7	3.93 5.17	98.0 92.0
Bacteria Reduction—						
Total count at 37° C., per c.c.	—343,200	—92.7	—373,000	—82.4	—165,000	—37.8
Total count at 20° C., per c.c.	—688,000	—92.2	—1,074,000	—90.1	—635,000	—70.0
B. coli at 37° C., per c.c.	— 77,880	—99.85	—96,300	—92.3	—45,000	—81.8

reduce suspended matter, albuminoid ammonia, required oxygen and bacteria. As to suspended matter, the reader will note that none of the Franklin tables shows its content in the raw sewage, but that it is given throughout in the Pennsylvania report.

The Franklin report contains tables comparing the per capita costs of the Landreth direct-oxidation process with other methods of sewage treatment, but the authors' apologies for these tables, combined with a paucity of details as to methods of computations, are sufficient reason for not reprinting the tables here.

The Franklin report does go into some detail to illustrate the diminution in unit operating costs with the increase in size of a Landreth plant, but here also it is uncertain just how many of the elements essential to operating a plant, such as was tested at Easton, are included. Apparently everything is omitted that does not pertain to the combination of lime, electrolytic and mechanical agitation treatment; that is, pumping and

TABLE VI. COMPARATIVE COSTS OF OPERATING A 2,000,000- AND A 10,000,000-GALLON LANDRETH SEWAGE-TREATMENT PLANT

Capacity, 2,000,000 gal. per day. Population, 20,000.	
The operation cost is based upon the following daily items:	
1600 lb. 90% lime per day at $6 per ton	$5.33
Current, 282 kw.-hr. per day at 2c.	5.64
Heat and light per day	2.00
Renewals	2.00
Maintenance and repairs	1.00
Labor:	
3 men—8-hour shifts, at $5, $4, $4.	
1 laborer at $3	16.00
Total	$31.97
This is 58c. per capita per year for operation, of which about 51% is for labor alone	
Capacity, 10,000,000 gal. per day. Population, 100,000.	
The operation cost is based upon the following daily items:	
8000 lb. 90% lime per day at $6 per ton	$26.75
Current, 1410 kw.-hr. per day at 2c.	28.00
Heat and light per day (estimated)	2.00
Renewals	10.00
Maintenance and repairs	6.00
Labor:	
1 superintendent	5.00
3 operators at $4	12.00
1 laborer	3.00
	$92.75
This is 34c. per capita per year for operation, of which about 22% is for labor.	

screening before and sedimentation and sludge treatment after the Landreth process appear to be left out of account, although in at least some of the cost tables already mentioned everything chargeable to sewage treatment, and some things that are not, seem to have been included by the engineers or authors whose figures are cited. With these words of caution, attention is directed to the Franklin Institute cost estimates for a 2,000,000-gal. and a 10,000,000-gal. plant shown in Table VI. These figures, converted to a 1 000 000-gal. rate of treatment, were compared with the Pennsylvania figures at the beginning of this article.

Avoiding the Ban on Special Legislation

How some state legislatures avoid constitutional prohibitions of special legislation affecting cities is well illustrated by the following summary of a recent Kansas statute apparently designed to affect one city only. The summary is taken from *Kansas Municipalities:* "Authorizing any city of the first class, from 20,000 to 25 000, in a county having a population not exceeding 60,000, with an assessed valuation of not less than $48,000,000, and containing two divisions of the district court, to request the county commissioners to improve permanently any main public road not exceeding four in number from the principal business center of such city.—S. B. 461."

Motor-Truck Impact on Roads Five Times Dead Load

Experiments of Bureau of Public Roads Indicate That Force Is Dependent on Speed, Power and Condition of Truck

IMPACT of motor-truck wheels upon pavement surfaces, reduced to equivalent static loads, is as much as five times the total dead load under certain conditions. This result is shown in tests being made by the Bureau of Public Roads at the Arlington Experimental Farm. The force of impact is found to be dependent on: (1) Height of drop; (2) total load; (3) condition of tires; (4) characteristics of springs, and (5) speed. It is also found to be greater when the power is on than when the truck is coasting. An abstract of a preliminary report made by E. B. Smith, senior assistant testing engineer, and J. T. Pauls, highway engineer, and published in the July issue of *Public Roads*, follows:

Realizing the destructive effect of the pounding of heavily loaded auto trucks on highways, the Bureau of Public Roads through its research department devised a system for testing impact. The general character of the apparatus used is shown in the accompanying illustration. Briefly, the device consists of a plunger fitted in

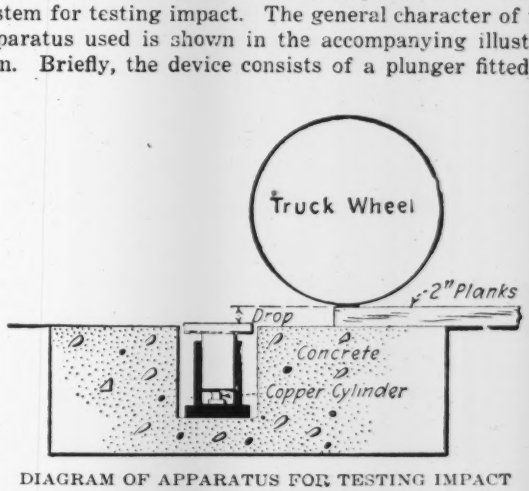


DIAGRAM OF APPARATUS FOR TESTING IMPACT

a casing and resting upon a small copper cylinder. These cylinders are carefully standardized and the impact is measured by the deformation of the copper when the truck wheel strikes the surface plate. A hole is left in the bottom of the casing so that there will be no cushioning effect of air. Various heights of drop are arranged for, by the use of different thicknesses of plank.

Only the rear wheels have been tested thus far, a steel bridge, which is automatically tripped as the front wheel passes, being used to protect the surface plate. The planks are moved back and forth so that the wheel lands directly in the center of the plunger at the different speeds.

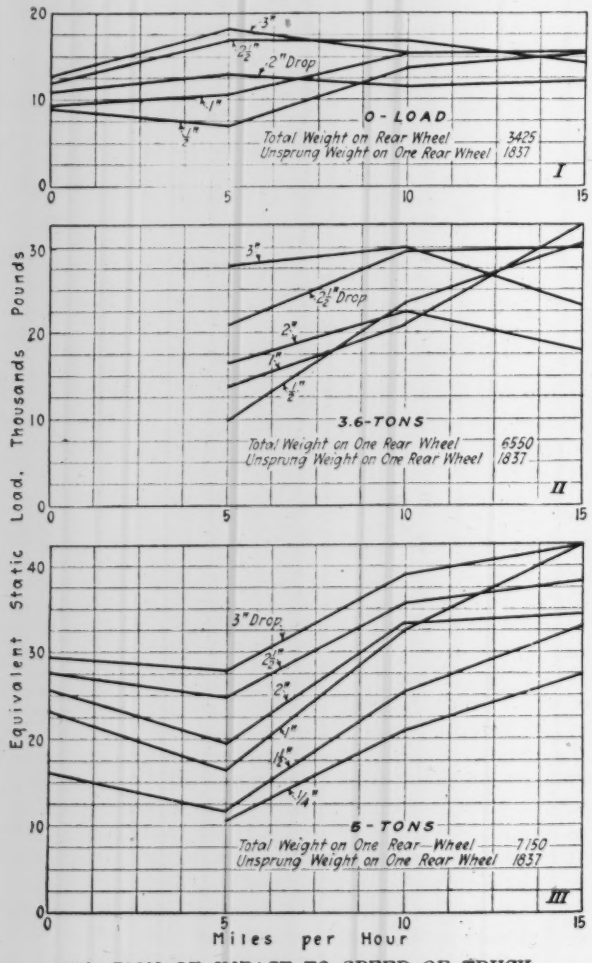
To obtain accuracy, the copper cylinders are accurately machined to ½ in. in diameter and carefully annealed. Five cylinders from each heat are tested in a machine under a pressure of 6000 lb., to determine the relation between static load and deformation for the heat. The variation from the mean deformation has been only 1.3% which is considered less than other experimental errors.

A three-ton United States Army, class-B truck with

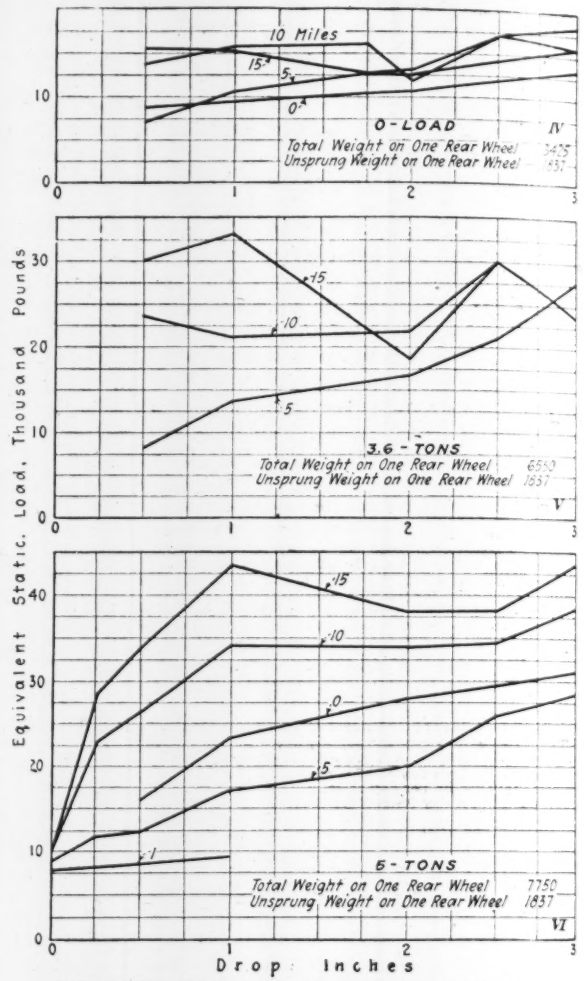
solid rubber tires is being used for these experiments. The truck weights are as follows: Empty, 11,400 lb.; on front wheels, 4550 lb., on rear wheels, 6850 lb., and of unsprung rear parts, 3675 lb. The tests were made with zero load, 3.6 tons and 5 tons. The weight on the rear wheels when loaded is 13,100 lb. for the former load and 15,500 lb. for the latter. The rear wheels of the truck are 40 in. in diameter, having two solid rubber tires which are 6 in. wide at the rim.

Only the effects of the simple falling of the truck from various heights were considered in the preliminary tests. Other conditions of impact will be investigated later. The deformations of the copper cylinders were reduced to equivalent static loads and plotted as shown in the accompanying curves. This may not be a perfect comparison of impact load, as such loads will probably produce a localized shattering effect which does not result from the application of a static load. For this reason the present methods of comparison are considered tentative, and subject to possible revision as the tests proceed. No attempt was made to determine the effect of the blows upon various pavement surfaces, but machinery and apparatus for making such tests are now under construction.

Curves 1, 2 and 3 indicate the general tendency of impact to increase as the speed increases, the loads being plotted with respect to the speed in miles per hour.



RELATION OF IMPACT TO SPEED OF TRUCK



RELATION OF IMPACT TO HEIGHT OF DROP

Curves 4, 5 and 6 show the same data plotted with heights of drop as abscissas. These curves indicate a general increase of impact with the increase in drop.

In conducting the experiments it was discovered that the action of the truck springs had a great influence on the impact results. Spring action is responsible for the relatively high values at zero speed in curves No. 3 and for the irregularities in 4, 5 and 6, plotted with respect to height of drop. When the wheel leaves the plank, the spring snaps open and produces a greater downward acceleration of the unsprung parts than that due to the action of gravity alone. Within the time of one vibration of the spring, the magnitude of impact at the landing point will depend upon the height of drop, whether it is less, equal to, or greater than the compression of the spring. If the period of vibration is such that the spring has acquired its maximum acceleration in opening and at this instant also lands at the point of application, the impact value will be at maximum. It will be at a minimum when conditions are such that the spring is returning to its closed position and is at the point of maximum acceleration in that direction as the impact occurs.

It was also noticed that the impact is appreciably affected by the condition of power, whether on or off.

If the impact occurs when the truck is coasting, it is less than when the power is on. This difference amounted in some cases to as much as 30 per cent.

The results of the preliminary tests are presented at this time to show the general tendency of impact values. It will be noted that under certain conditions the impact is as much as five times the total dead load. It is hoped that as the tests proceed they will give road-design data and lead to the establishment of rules and laws for the allowable load and speed of motor trucks.

Engineering Standards Committee Proposes New Constitution

New Draft Provides for Taking in Other Societies on Equal Basis—Association Plan for Outside Financing Dropped

A NEW constitution for the Engineering Standards Committee has been submitted for approval to the governing boards of the five societies which originally joined in forming that committee. The draft was prepared by representatives of the five societies in conferences held during July and August, and was finally adopted by the committee Aug. 16. It is a substitute for the constitution of an American Engineering Standards Association which was drafted by the committee in May and presented to the societies for approval; so much opposition developed in the societies that the association plan was subsequently reconsidered by the committee.

In the new draft, printed below, provision is made for admitting to membership in the committee other societies than the original five, just as was done in the associations' constitution. However, the plan of financing the work partly by outside contributions finds no representation in the present draft. With respect to ultimate control, the form of organization now proposed is identical with that of the association in that the committee will be controlled by all the bodies having representation in it, rather than by the five original societies alone. Another point of identity between the present constitution and the preceding draft is the omission of any definition of the scope of work contemplated, this work being described only by the general term "engineering standardization."

Present indications are that the governing boards of the societies will not be in a position to take final action on the proposed constitution before October.

Revised Constitution of American Engineering Standards Committee

Article I. Name

Sec. 1. The name of this committee shall be the American Engineering Standards Committee, hereinafter referred to as the committee.

Article II. Objects

The objects of the committee shall be:

Sec. 2. To provide means by which various organizations engaged in formulating engineering standards may coöperate with one another, thus avoiding the duplication of standardization work and the promulgation of conflicting standards.

Sec. 3. To collect and make accessible to organizations and individuals information concerning standardization work in the United States and foreign countries.

Sec. 4. To receive and pass upon recommendations for standards submitted to it by other organizations in accordance with its rules of procedure, with the object of establishing American engineering standards; but not to formulate standards.

Sec. 5 To promote in foreign countries the knowledge of recognized American engineering standards

Sec. 6. To act as the authoritative channel of coöperation in international engineering standardization.

Article III. Membership

Sec. 7. The committee shall be composed of not more than three representatives from the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Society for Testing Materials, the Government departments of War, Navy, and Commerce, and from each of such other organization (or groups of organizations) of national scope as may be approved as hereinafter provided. The vote of the committee shall lie with these representatives, who shall be termed members.

Sec. 8. The number of representatives any organization or group of organizations may appoint shall be determined by such considerations as the volume, character and importance of its standardization work, if any, together with its standing and total membership.

Sec. 9. Any organization or group of organizations desiring representation on the committee shall make formal application therefor in writing, setting forth the scope of its standardization interests and activities and the number of its members. This application shall be considered by the committee, and, if approved by three-fourths of those present and voting, shall be submitted with recommendations to each organization represented on the committee. These recommendations shall stand approved unless formal objection from more than one-fourth of the organization or groups of organizations represented is received within 90 days from the date on which such recommendations were mailed.

Sec. 10. Any organization or group of organizations appointing representatives to the committee shall agree to assume the financial obligations herein set forth and to abide by the constitution, by-laws, and rules of the committee. In case of members appointed by Government departments or bureaus, it is understood that financial support is not required until such time as proper authorization therefor can be obtained.

Sec. 11. Initially, each organization or group of organizations shall appoint its first representative to serve three years, the second to serve two years, and the third to serve one year. After the first year all appointments shall be for three years.

Sec. 12. A member whose term of office has expired may be reappointed. A vacancy shall be filled by the organization or group of organizations from which the retiring member was originally appointed, such appointment to be for the unexpired term.

Sec. 13. Any organization or group of organizations may withdraw its representatives from the committee upon notice in writing, provided the dues for the current calendar half year have been paid.

Article IV. Officers

Sec. 14. At its annual meeting the committee shall elect from its membership a chairman and vice-chairman, who shall not be representatives of the same organization or group of organizations. Officers so elected shall assume office on Jan. 1 and serve for one year, or until their successors are elected. These officers shall not serve for more than three consecutive terms. Vacancies may be filled by election at any regular or special meeting, provided notice has been given in the call for the meeting.

Sec. 15. The chairman shall be the executive officer of the committee, shall approve all expenditures, and countersign all vouchers. He shall preside at meetings of the committee. He shall be chairman of the executive committee, on which he shall be the representative of the

organization or group of organizations appointing him, and shall be ex-officio member of all other committees.

Sec. 16. In the absence of the chairman, his duties shall be performed by the vice-chairman. The vice-chairman shall be vice-chairman of the executive committee, on which he shall be the representative of the organization or group of organizations appointing him.

Sec. 17. In the absence of both chairman and vice-chairman, the duties of chairman shall be performed by a member of the executive committee.

Sec. 18. A secretary, who shall not be a member of the committee, shall be engaged by the executive committee.

ARTICLE V. EXECUTIVE COMMITTEE

Sec. 19. At its annual meeting the committee shall elect from its membership an executive committee, consisting of one representative of each organization or group of organizations represented on the committee, and may delegate to it any of its powers except that of approving "Recommended Practices," "Tentative Standards," or "American Standards."

Sec. 20. Members elected to the executive committee shall assume office on Jan. 1 and serve for one year or until their successors are elected. Vacancies may be filled for the unexpired term by vote of the executive committee, the new member to be a representative of the organization or group of organizations by which the retiring member was appointed.

Sec. 21. A quorum of the executive committee shall consist of a majority of its members.

ARTICLE VI. MEETINGS

Sec. 22. The committee shall hold at least four regular meetings each year, the last of which shall be the annual meeting. It may hold additional meetings at any time at the call of the chairman on not less than 10 days' notice.

Sec. 23. A quorum of the committee shall consist of a majority of its members.

ARTICLE VII. APPROVAL OF STANDARDS

Sec. 24. The committee shall formulate rules under which committees to create standards shall be constituted and organized and shall receive and pass upon recommendations for standards which may be submitted by any competent body, to be known as the Sponsor.

Sec. 25. Any proposed standard submitted to and approved by the committee shall be known either as a "Recommended Practice" or as a "Tentative Standard," and when, in the opinion of this committee after approval by the Sponsor it has proved its suitability, it shall be known as an "American Standard."

Sec. 26. The approval as "Recommended Practice" or as "Tentative Standard" of any standard submitted to the committee shall require the affimative vote of three-fourths of the committee; the advance of status to "American Standard" shall require an affirmative vote of 90% of the committee. Such vote shall be by letter ballot. Letter ballots may be ordered at any regular or special meeting of the committee.

Sec. 27. A "Recommended Practice" or "Tentative Standard" may be revised at intervals of not less than one year, by the same procedure as that required for its original approval. A period of not less than one year shall intervene between the last revision and the admission to "American Standard."

Sec. 28. An "American Standard" may be revised at intervals of not less than three years by the same procedure as required for its original approval.

ARTICLE VIII. FINANCES

Sec. 29. Each organization appointing representatives on the committee shall pay annual dues of $500 for each representative. These dues shall be paid semi-annually. Any organization or group of organizations in arrears for dues for more than one year will thereby lose its right to representation on the committee.

Sec. 30. Funds of the committee shall be in the custody of the secretary, who shall be placed under suitable bond, and they shall be disbursed by him upon vouchers countersigned by the chairman or vice-chairman.

Sec. 31. The fiscal year of the committee shall terminate with the 31st day of December.

ARTICLE IX. BY-LAWS

Sec. 32. The committee may adopt by-laws in accordance with this constitution.

ARTICLE X. AMENDMENTS

Sec. 33. Amendments to this constitution must be proposed in writing at least 30 days before the meeting of the committee at which they are to be voted upon, this vote to be upon the amendments as originally proposed or as further amended at the meeting. If approved by three-fourths of those present they shall be referred to the organization or groups of organizations represented on the committee, and shall become operative only when they have been approved by three-fourths of such organization or groups of organizations.

A Water-Works Profit-and-Loss Account

AMONG the few municipally-owned water-works that keep a profit-and-loss account is that of Springfield, Mass. A summary of this account for the year which ended Nov. 30, 1918, taken from the annual report of A. R. Hathaway, water registrar, follows:

OPERATING REVENUE		
I. Earnings from sales of water to private consumers	$474,439.47	
II. Less abatements, refunds, etc.	1,312.01	
		$473,127.46
III. Earnings from sales of water to City of Springfield: Earnings based on prescribed rates for water supplied were $71,000.10, but no payments were made therefor, as per city ordinance		.....
III-A. Water used by municipal water-works and included in its operating expenses		84.85
Total operating revenues (water)		$473,212.31
OPERATING EXPENSES		
IV. Source of supply	$43,844.94	
V. Transmission expense	3,880.88	
VI. Distribution expense	48,031.28	
VII. Commercial expense	15,031.99	
VIII. General expense	31,015.97	
IX. Undistributed expense	8,556.78	
	$148,361.84	
IX-A. Public-safety expense	15,202.13	
	$107,563.97	
X. Depreciation reserve charge (for distribution system)	36,000.00	
Total operating expenses		203,563.97
Operating profit		$269,648.34
XI. Nonoperating income (sundry sales, not water)		4,596.52
Gross income		$274,244.86
DEDUCTIONS FROM GROSS INCOME		
XII. Interest on bonded debt (net)	$69,452.95	69,452.95
Net income (carried to surplus)		$204,791.91

Engineer Casualties Third Highest

Only the infantry and the Signal Corps suffered heavier battle casualties in the war than the Engineer Corps, according to recent figures compiled by the War Department. Among each 1000 enlisted men in the infantry reaching France there were 270 killed or wounded. Among each 1000 in the Signal Corps the casualties were 50, and in the Engineer Corps 43. The percentage of casualties in the Tank Corps, artillery and air service, among enlisted personnel, were 3.8, 3.3 and 0.2%, respectively. It is also announced that among all enlisted men battle deaths were 8 in each thousand; among emergency officers 1.1% and among regular Army officers 1.4 per cent.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Much Valuable Matter Well Presented

REVIEWED BY F. W. DEAN
Consulting Engineer, Lexington, Mass.

TIMBER: Its Strength, Seasoning, and Grading—By Harold S. Betts, M.E., Forest Service, U. S. Department of Agriculture. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 234; illustrated.

It is a pleasure for a reviewer to be able to compliment a book without reservation. Such is the feeling of the present writer, for he can state that the book on "Timber" by Mr. Betts contains much valuable matter well presented. The book fills a long-felt need, for it contains most useful information, with reference to aspects of timber, that is of interest and value to anybody who uses it, or seeks information concerning it, whether he is an engineer, an architect, a vehicle builder, a furniture maker, a lumber dealer, or what not.

Up to this time nobody has known where to find printed information about timber in general—whether concerning physical qualities, distribution, methods of piling or prevention of decay, and, it may be added, the breaking down of certain superstitions concerning timber. The Associated Factory Mutual Insurance Companies issued, a few years ago, a pamphlet on the decay and preservation of timber which engineers and architects have found of great value, but in the book under review similar matter as well as much other of equal importance may be found, and users of timber are to be congratulated upon the availability of a book in which most questions that are likely to arise concerning timber are answered.

The book first considers the timber resources of the country and the distribution of different kinds. This is followed by six extensive tables which alone are worth the price of the book. These give the physical properties of all kinds of timber—chiefly those grown in the United States, such as weights, shrinkage, modulus of rupture, crushing strength, stiffness, hardness, shock-resisting ability, and shearing strength, all referred to being white oak from Hendricks County, Indiana, as a standard. It is interesting and surprising that so many woods are superior to oak in most properties. It is to be regretted that more information is not given concerning eucalyptus, which has such remarkable qualities, and which is being somewhat exploited in California, to say nothing of its natural habitat, Australia. It is mentioned only once in the tables, and somewhat obscured under the "Gum" headings. The *Eucalyptus globulus* from Alameda County, California it appears, has a modulus of rupture of 130, a longitudinal crushing strength of 149, transverse 140, a modulus of elasticity in transverse bending of 153, hardness of 128, shock resistance of 105, and longitudinal shearing strength of 118, all referred to oak as 100. The banner wood for all of these properties is greenheart from Demerara, South America, which has qualities nearly double those just given—except the last three—and, singularly, a shock-resisting quality of only 90. The methods of determining the various properties already named are described and are illustrated by diagrams. A chapter is devoted to the effect of moisture on timber.

Under the heading "Strength," 82 pages are allotted to the strength of timber in its larger aspects as used in structures such as buildings, wagon spokes, axles, telegraph poles, cross-arms and packing boxes. This chapter includes matter on the structure of wood—growth, grain, knots, checks, shakes—and all kinds of defects, sap wood, spring wood, summer wood, decay, insect attacks, grading, effect of seasoning and working stresses in wet, moist and dry places (but not hot places). It is shown that white hickory buggy spokes are no better, contrary to the general opinion, than red and mixed colors, and that the strength is a factor of the weight. It was found that oak buggy shafts are as good as hickory except that after breaking they are weaker. Similarly, tests of maple and hickory wagon axles show the latter to be stronger, better able to stand shocks and to support more load after breaking. Trussing wooden axles in the usual way is of little value.

One of the most important chapters is that devoted to the seasoning of wood. Here are considered moisture in per cent. of dry weight, direction and amount of shrinkage, prevention of injury in seasoning, methods of piling lumber, infection of good lumber from bad, kiln-drying and types of kilns.

In the description of methods of preserving lumber it is not observed that anything is said about boring and ventilating columns, which is now generally abandoned, or whether in bolting beams together an open space between is of any value (which is now abandoned on account of fire risk) or of the value of coating the ends of columns and beams with preservatives, which is important.

It has always been difficult for engineers and architects to know just how to specify the timber they want. They have not usually known, but much light will be afforded them upon the subject if they will read the chapter devoted to the grading of lumber, and the extracts from the specifications of various companies given in an earlier chapter.

Handbook on Employment Management

EMPLOYMENT MANAGEMENT: (The Handbook Series) Compiled and Edited by Daniel Bloomfield, Author of "Labor Maintenance," Partner in Bloomfield & Bloomfield, Boston, Consultants in Employment Management and Industrial Relations; With an Introduction by Meyer Bloomfield, Author of "Labor and Compensation," "Youth, School and Vocation," etc. New York: The H. W. Wilson Co. Cloth; 5 x 8 in.; pp. 507.

One of a handbook series on various social movements, this collection of articles treats the relatively new subject of employment management. An extensive bibliography, which shows the rapid development in this field, is included. The articles are selected from widely distributed sources, and cover all the essential divisions of the subject, including the aims of the new science, the problems of labor maintenance, the employment manager, the employment department, the cost of labor turnover, the medical examination of

workers, coöperation in management and service features. The appendix, although not satisfying from a typographical standpoint, contains typical forms, used in employment departments, which may prove suggestive.

United States Housing Corporation

HOUSES, SITE PLANNING, UTILITIES: Report of the U. S. Housing Corporation, U. S. Department of Labor, Vol. II—Washington, D. C.: The Department. Cloth; 9 x 12 in.; pp. 524; illustrated. $1.50 from Superintendent of Documents.

Certain Congressmen, secure in the knowledge that the war has been won, are satisfying the reactionary real-estate interests in their respective constituencies by attacking the Government's housing operations during the war. So far they have confined themselves to indirect attacks and have not seen fit to call any of the officials of the two Government housing bureaus to direct examination as to the proprieties or efficiencies of their respective organizations. However, until these officials have had a chance to defend themselves, those of them connected with the United States Housing Corporation, at least, will have an admirable defense in the second volume of the report of that corporation, just issued, which is by far the most elaborate and valuable practical compendium on housing ever published.

This second volume is devoted, according to its title, to "housing, site planning, and utilities." The larger part of the book, which is a big one, is filled with illustrations of the plan, layout and detailed house design for the many projects designed, started, or completed, under the direction of the Corporation. These are of inestimable value to the housing operator of the future. They bring together, as have nowhere else been brought together before, the best ideas of our town-building engineers and architects all over the country, for, as is probably well known, each project was the work of an individual engineer and architect. The central office at Washington only viséd the designs and laid down certain fundamental broad principles.

Preceding the general plans and descriptions are a number of paragraphs expository of the whole science of town planning and building. In them are laid down the principles on which the housing corporation went about its development of any particular project, the method of investigating the needs of the community, the report on the facilities required, the methods of design, and, finally, of construction. In the latter are included the details of municipal utilities, surface improvements and other engineering matters which have been described fully in previous issues of *Engineering News-Record*, and which were developed under the efficient direction of John W. Alvord, the chief engineer of the Corporation. Finally, there are in this part of the book chapters by the Corporation's experts critical of the work which the Corporation did. It is particularly gratifying in a Government report to see this frank acknowledgment of the obvious fact that during the speed and clamor of war many things had to be done which in calmer times could, obviously, be improved.

The final part of the book is given over to tabular records of the work of the Corporation. Here are contained all the statistics of performance which, while valuable as a record of what the Corporation did, are not particularly useful for future workers in similar projects. For such workers, however, there are a multitude of cost records arranged, under the heads of all the details of a housing project, per family accommodated and per unit of material used. These tabulations are among the most valuable records of the work of the Corporation. Finally, the book contains the various forms, instructions to investigators, designers, surveyors, engineers, etc., estimating suggestions, and various drawings giving the standard details of construction.

Democracy, Industry and Government

DEMOCRACY IN RECONSTRUCTION—Edited by Frederick A. Cleveland, Formerly Chairman of President Taft's Commission on Economy and Efficiency, and Joseph Schafer, Professor of History in the University of Oregon and Vice-Chairman of the National Board for Historical Service. New York: Houghton Mifflin Co. Cloth; 5 x 8 in.; pp. 506.

Among the changes wrought by the war none has been more swift and profound than the democratization of government and industry. Dozens of books have had these changes as their theme; notable among these is the one comprising the series of essays on a plan formulated by the editors of this volume and executed by nearly twoscore writers of their selection. Much of the volume is devoted to questions of government, industry or society that have a more or less direct appeal to the engineer.

The six main divisions of the bok deals with the ideals and the institutions of democracy, and with after-war social, labor, transportation and political problems. The titles and authors of some of the separate chapters are as follows: "The Underlying Concepts of Democracy" and "Democratization of Institutions of Public Service," by W. W. Willoughby; "Democracy and Health," by Dr. Esther Lovejoy; "The Educational Lessons of the War," by S. P. Capen and C. R. Mann; "Military Motor Transport—Its Lessons for Peace," by F. A. Cleveland; "Motorized Highways the Bases of a National Transport System," by R. C. Hargreaves; "Need for Readjustment of Relation Between Executive and Legislatve Branches of Government," by F. A. Cleveland; and "The Evolution of Democracy—A Summary," by C. A. Beard.

In the chapter on "Public Service" Mr. Willoughby comes out strongly for a Federal Board of Public Works. Both Mr. Willoughby and Mr. Cleveland bring out many strong points concerning the executive branches of government. In his final summary Mr. Beard says: "Having conquered political institutions of royal and aristocratic origin, democracy is now at work on economic institutions . . . the supreme test of the power of the people to conduct government for themselves is now at hand."

PUBLICATIONS RECEIVED

Under a Postoffice Department ruling made applicable to *Engineering News-Record* in July, 1919, it is no longer possible to give the prices of new publications announced under this head or of books reviewed in the preceding columns. Readers will therefore have to obtain this information as best they can. Most of the public documents and of the pamphlet announced may be obtained free on application, or at least by paying postage. So far as possible, the name and address of the publisher of each book and pamphlet are given in each entry.

THE BOOK OF THE NATIONAL PARKS—By Robert Sterling Yard, Chief of the Educational Division, National Park Service, Department of the Interior; Author of "The National Parks Portfolio," "The Top of the Continent," etc. New York: Charles Scribner's Sons. Cloth; 6 x 9 in.; pp. 420; illustrated

CONSERVATION IN 1918—By James White, F.R.G.S., M.E.I.C. Assistant to Chairman, Deputy Head, Commissioner of Conservation. Ottawa, Can.: The Commission. Paper; 7 x 10 in.; pp. 88.

DISTILLED WATER—By William M. Booth, Syracuse, N. Y. Reprinted from Vol. X, 1917, *Transactions* of the American Institute of Chemical Engineers. New York: D. Van Nostrand Co. Paper; 6 x 9 in.; pp. 83; illustrated.
Deals with history and development of water stills; gives bibliography; presents many letters from laboratories, manufacturers, etc., describing stills used.

ENGINEERING EDUCATION: Essays for English Selected and Edited by Ray Palmer Baker, M.A., Ph.D., Professor of English in the Rensselaer Polytechnic Institute. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 5 x 8 in.; pp. 185.

HOURS OF WORK AS RELATED TO OUTPUT AND HEALTH of Workers: Research Report No. 18, July, 1919. Metal Manufacturing Industries. Boston, Mass.: National Industrial Conference Board. Paper; 6 x 9 in.; pp. 62.

INCIDENTS IN THE LIFE OF A MINING ENGINEER—By E. T. McCarthy, M.I.M.E., M.Am., I.M.E. London: George Routledge and Sons, Ltd. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 384.

LES METHODES MODERNES DE LA RESISTANCE DES Materiaux—By M. Bertrand de Fontviolant, Professeur à l'Ecole Centrale des Arts et Manufactures. Paris, France: Gauthier-Villars & Cie. Paper; 7 x 10 in.; pp. 82.

MINERAL RESOURCES OF THE UNITED STATES: Preliminary Report, 1918; Introduction by Edson S. Bastin; Statistics Assembled by Martha B. Clark from Data Furnished by Specialists of the Division of Mineral Resources. Washington, D. C.: United States Geological Survey. Paper; 6 x 9 in.; pp. 106.

MUNICIPAL MARKETS IN CITIES HAVING A POPULATION of Over 30,000, 1918—Washington, D. C.: Bureau of the Census. Paper; 9 x 11 in.; pp. 56.

NEW TOWNS AFTER THE WAR: An Argument for Garden Cities—By New Townsmen. London, Eng.: J. M. Dent & Sons, Ltd. Paper; 5 x 7 in.; pp. 84.

NEW YORK STATE DEPARTMENT OF LABOR: Labor Laws Enacted 1919—Issued Under the Direction of the Industrial Commission, John Mitchell, Chairman; Prepared by The Bureau of Statistics and Information. Albany, N. Y.: The Department. Paper; 6 x 9 in.; pp. 72.

NEW YORK STATE ENGINEER AND SURVEYOR'S REPORT, 1918—Albany, N. Y. Office of the State Engineer and Surveyor. Cloth; 6 x 9 in.; pp. 303; illustrated.

THE NILE PROJECTS—By Sir William Willcocks, K. C. M. G., Late Director General of Reservoir Projects, Cairo, and Director General of Irrigation Projects, Bagdad. Cairo, Egypt; The Author. Paper; 7 x 10 in.; pp. 179; illustrated.

ONE THOUSAND TECHNICAL BOOKS: A Selected List with Annotations Emphasizing Especially Elementary Practical Books—Compiled by Herbert L. Cowing. Washington, D. C.: American Library Association. Paper; 6 x 9 in.; pp. 123.
Designed primarily as a selection of "elementary practical books," but also includes "many books of a more advanced type, and aims to provide A. L. A. representatives and public libraries with a fairly adequate basis for strengthening their technical collections in accordance with local needs." The books are classified under basic engineering subjects: Civil, mechanical and electrical engineering; building; mining and metallurgy; chemical technology; and miscellaneous. There is a subject index.

PETROLEUM IN 1917—By John D. Northrop. Washington D. C. U. S. Geological Survey. Paper; 6 x 9 in.; pp. 218.

POTASH RECOVERY AT CEMENT PLANTS—By Alfred W. G. Wilson, Ph.D., Special Investigator for the War Trade Board. Ottawa, Can.: Department of Mines. Paper; 7 x 10 in.; pp. 34; illustrated.

PRICES OF COAL AND COKE, 1913-18—By C. E. Lesher; Prepared in Coöperation with the U. S. Fuel Administration and War Industries Board. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 115; illustrated.

PRICES OF LUMBER: History of Prices During the War—By R. C. Bryant, Industrial Examiner, Forest Service. Published in Coöperation with the Forest Service Department of Agriculture. Washington, D. C.: War Industries Board. Paper; 6 x 9 in.; pp. 108; illustrated.

THE RELATION OF DEPRECIATION TO INVESTMENT—By C. W. Hawley, C.E., Wilkinsburg, Penn. Paper Read at the Twenty-third Annual Convention of the Pennsylvania Water Works Association, Atlantic City, N. J., Oct. 18, 1918. Paper; 6 x 9 in.; pp. 16.

ROAD MATERIALS IN THE VICINITY OF REGINA, Saskatchewan—By L. Reinecke. Ottawa, Can.: Geological Survey. Paper; 7 x 10 in.; pp. 28; illustrated.

SOCIALISM AND AMERICAN IDEALS—By William Starr Meyers, Ph.D. Professor of Politics. Princeton University, Princeton, N. J.: Princeton University Press. London: Humphrey Milford, Oxford University Press. Cloth; 5 x 8 in.; pp. 89.

STANDARDIZATION OF SHIP MATERIALS—By Fred T. Llewellyn, Federal Shipbuilding Co., Kearny, N. J., Chickasaw Shipbuilding Co., Mobile, Ala. New York: The Author, 71 Broadway. Paper; 6 x 9 in.: pp. 70.

STEAM TURBINES: A Practical and Theoretical Treatise for Engineers and Students; Including a Discussion of the Gas Turbine—By James Ambrose Moyer, S.B., A.M., M. Am. Soc. M.E., Etc. Fourth Edition, Revised and Enlarged. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 495; illustrated.

STUDIES IN THE CONSTRUCTION OF DAMS: Earthen and Masonry; Arranged on the Principle of Question and Answer for Engineering Students and Others—By Prof. E. R. Matthews, B.Sc. (Eng.) Assoc. M. Inst. C. E., etc. London, Eng.: Charles Griffin & Co., Ltd. Philadelphia, Penn.: J. B. Lippincott Co. Paper; 6 x 9 in.; pp. 43; illustrated.
An elementary exposition, by the question and answer method, of the design and, less fully, the construction of dams and reservoirs. Intended for students who have to pass examinations to the British technical societies.

TELEGRAPHS AND MUNICIPAL ELECTRIC FIRE-ALARM and Police-Patrol Signaling Systems: Census of Electrical Industries, 1917—Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 61.

TOWN IMPROVEMENT: A Review of the Principles by which Physical Improvement in the Town or City may be Accomplished, With Observations as to the Effect of Such Improvement Upon the Life of the Community—By Frederick Noble Evans, M. L. A., Assistant Professor of Landscape Gardening in the University of Illinois, etc. New York and London: D. Appleton & Co. Cloth; 5 x 7 in.; pp. 261; illustrated.

ZONING AND CITY PLANNING FOR PORTLAND, OREGON—City Planning Commission, Charles H. Cheney, Consultant. Portland, Ore.: The Commission. Paper; 6 x 9 in.; pp. 55; illustrated.
A preliminary review, designed to show need for zoning and presenting various local data, together with Oregon State Zoning Act of 1919.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

A. A. E. Chapter to Start Business Courses for Members

One of the activities of the Chicago Chapter of the American Association of Engineers during the coming months will be a series of business courses for the members of the chapter. The courses will be started soon. The four which are to begin in September are in business administration, to be taught by Prof. Henry Post Dutton, an industrial engineer who is at present acting in an advisory capacity to the Canadian commission engaged in redrafting compensation schedules of civil service employes; in industrial management, by D. T. Ham, formerly an instructor in Harvard University and now connected with La Salle Extension University; civics, by V. Yarros, senior instructor under Graham Taylor, president of the Chicago School of Civics and Philanthropy; and public speaking, by Prof. Benjamin F. Bills, formerly of the University of Chicago. The course in business administration will include functions, standards of efficiency and evolution of organization and management; the organization of a business; efficiency systems; selection of employees; training of men; and other subdivisions of the general subject. The cource in industrial management will include such subjects as locating the indsutry, organization for operation, factory layout and equipment, control of production and control of labor. The civics will embrace the usual subjects, and the course in public speaking will develop impromptu talking, the extempore speech and the formal address. More than a hundred members of the Chicago Chapter have signified their intention of enrolling in one or more of these courses.

Colorado Society of Engineers Keeps Its Members In Employment

Not many engineers in Colorado need be idle more than a few days at a time if they are members of the Colorado Society of Engineers. This organization handles the employment question so efficiently that not a single man of the 300 members lacked a position when a representative of *Engineering News-Record* looked over the files recently.

C. R. Daniels, the secretary, has educated employers to come to him with their requests. His method of introduction is to send two to three engineers whose qualifications fit the requirements most nearly. The applicant takes with him to the prospective employer a stamped postcard introduction. The employer is re-requested to sign and return the post-card, which is ad-

dressed to the society, answering the single question as to whether or not the man was employed. Receipt of this card immediately clears the secretary's record and obviates the great difficulty, which practically all free employment bureaus have, of knowing what results have been obtained from their efforts in bringing the man and the position together. It is notoriously true that few engineers who have been helped in this way are sufficiently grateful to the organization set up by their brother engineers, to notify headquarters as to their success or failure in obtaining work. Mr. Daniels' stamped post-card introduction puts the burden on the employer, and that burden is so slight that he rarely fails to assume it.

A weekly employment letter is sent out indicating positions open and applicants for employment, the idea being to get the aid of members in obtaining jobs (they call them jobs in Colorado) for members out of work, and better jobs for those already employed. The list is kept more or less blind, for obvious reasons.

The paid employment agencies watch the activities of the organization closely. Their engineering business is reported to have dwindled since the engineers established the free bureau. In the Aug. 5 letter 11 positions were open: Three in Wyoming, two in Colorado; one each in Idaho, Montana, Ohio, Old Mexico and Utah. The salaries ranged from $135 for an assistant computor to $200 for mechanical draftsmen. Ten experienced engineers had sent in applications. Most of these were nonmembers or members wanting something better than positions held.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Omission of Prices From Book Reviews

Sir—I notice in your September 4 issue a communication from C. J. Tilden relating to the omission of prices from your book review. I consider this communication very much to the point. Where one is obliged to purchase a considerable number of books each year to keep posted and up to date in his work, especially at the present Government salaries, it is very essential that the price should be given, and without this information at hand undoubtedly a considerable amount of correspondence is caused which would otherwise be unnecessary. W. A. E. DOYING,

Inspecting Engineer, The Panama Canal.

Washington, D. C.

Suggested Course in Highway Engineering

Sir—The writer has followed with keen interest the discussions and articles bearing on engineering education which have appeared in *Engineering News-Record* during the past three years. I am taking the liberty to submit the outline inclosed, which seems to me to cover the essential subjects as fully as possible in a four years' course.

Prerequisites: Required number of units in English, history, mathematics, languages and science.

FIRST YEAR:
- Trigonometry
- Drawing
- Introductory course in elementary mechanics
- Plane surveying
- History of science of engineering
- Reading of current topics related to engineering and the economic development of natural resources—selected modern language.

SECOND YEAR:
- Analytics
- Descriptive geometry
- Perspective and structural details
- Higher surveying, reviewing work on first year in leveling, cross-sections, volumes, etc.
- Elementary calculus
- Elementary chemistry
- Technical English
- Modern language
- Collateral reading—selected

THIRD YEAR:
- Advanced calculus—applied mechanics
- Comprehensive course in materials of construction, including testing
- Structural geology—field and laboratory work in classification of rocks and rock minerals
- Design of bridges—beam and simple truss, bridge floors, preservatives
- Design of simple concrete structures—field and laboratory work in mixing, placing, inspecting, and testing road construction—elementary course.
- Technical report writing—reviews on current articles—selected

FOURTH YEAR:
- Engineering law
- Specification writing
- Economics, banking, administration, cost-keeping
- Complete location, design and estimate of a road with the various types of surface, including bridges, culverts, guard railing and signs
- History, constitution, and codes of ethics of the leading architectural and engineering societies
- Collateral reading and analyses of same
- Use of tables, charts and graphs in engineering computations and reports
- The location and design of highway to stand in lieu of a thesis.

Nothing is indicated as to the number of terms required for the various courses, but the nature of each subject will determine that.

I should like very much to have through your columns the criticisms of other highway engineers on this outline. R. T. BROWN, Chief of Surveys,

South Carolina Highway Department.

Columbia, S. C.

Thirty-five Minute-Angle Method of Traversing Held Inaccurate

Sir—Referring to the article, "Traversing by a Thirty-Five-Minute-Angle Method" by John H. Sawkins in *Engineering News-Record* of Aug. 21, 1919, p. 373, I would like to state that such procedure should not be attempted, at least in cases where more or less accuracy is required. Emphatically, I protest against the author's statement, "it gives results as close as the stadia and perhaps superior to it, since the computation is so simple." A good instrumentman who has had considerable practice in stadia surveying is able to read the rod at a distance of 100 ft. within 1 ft. correctly, at 200 ft. within 2 ft., etc. Considering the author's method, and referring to his sketch, a mistake of $\frac{1}{10}$ ft. (practically 1 in.) in the set-off D and D′ which the flagman has to lay off, will cause a mistake of 1 ft. in the required distance. How easily such mistakes must occur can be readily seen if one considers how hard it is to

lay off an angle of 90° by approximation. If the angle is more or less than 90° the distance D and D′ will increase or decrease in proportion, sometimes for several inches, and when multiplied by 100 will affect the required distance by that many feet. In case the flagpoles are not in line with the vertical wire of the telescope or the flagpoles are inclined either to the right or left, mistakes in measuring the distance D and D′ will occur again.

A similar case was experienced by me once and convinced me that such methods look very good in theory but are incorrect in practice. Working on a topographic survey in California, I underestimated the distance from my instrument to a certain hill to which I sent the rodman, and when he arrived there and put up his rod it fell short within the two wires of the telescope. The rod was 20 ft. with extension. To save time I tried the following experiment, which theoretically is without fault: I took a "shot" at the foot of the rod, which was plainly visible, recorded the reading of the vertical arc of the instrument, then sighted to the top of the rod, recording the reading again. The difference between the second and first readings gave me the angle included between the two rays. The cot of this angle, multiplied by the length of the rod, gave me the required distance—only it was far from being correct, as I found out later. Subsequent experiments with this method convinced me that I could not obtain a correct distance within 75 to 100 ft. Theoretically, this method can only be applied to long distances, for the smaller the angle between the two rays the more will the angle between the stadia board and the rays approach 90°. I also tried this method at short distances, being especially careful to have the telescope and the foot of stadia board at the same elevation; nevertheless the results were not correct. Mr. Sawkins' and the above-mentioned methods are alike, only the triangles lie in different planes.

Finally, I would like to state that it is just as convenient to carry one stadia board as two flagpoles; that it shifts the responsibility for correct distance reading to the proper person, namely, the instrumentman; and that the stadia method saves time, eliminating the location of D′ and measuring the distance D and D′. Running a correct traverse with Mr. Sawkins' method is, in my estimation, impossible, although it might prove useful for long-distance side shots where little accuracy is required. However, why not use intersection in such a case, either using the rod as intersecting point, or, if available, prominent points?

K. F. JAEGER,
Fort Douglas, Utah. Engineer Depot.

More Against Mortar Test for Concrete

Sir—In *Engineering News-Record* of May 22, 1919, p. 1006, there appeared an article by Prof. C. C. Williams entitled "Mortar Test Does not Insure Good Concrete Aggregate." There is a point in connection with this to which I wish to call attention.

These experiments were carried on at the United States Government Explosives Plant C, Nitro, W. Va., by myself as engineer of tests, assisted by Cary P. Butcher. Professor Williams was in nominal charge of this work as supervising engineer, and his article was based on data abstracted from my report to him on the work of the testing laboratory. One point which seems vital to me in the light of recent research was overlooked by Professor Williams. The point in question did not appear in my report, but was noted in the records of the tests which were on file in the office and are now in my possession. I refer to the amount of water used in making the mortar for the tensile strength tests.

To give comparative results, it appears from recent experiments that the water-cement ratio should be constant. However, in the study made at Nitro, the several aggregates were quite different in character, and although the same amount of water (10.5%) was used in each case, the consistencies of the several mortars were quite different. For instance, the mortar made from limestone screenings was quite dry, due to the fact that there was a large amount of rock dust present (often as high as 15% passing a No. 100 sieve) and the further fact that the limestone itself absorbed a considerable part of the water. On the other hand, the mortar made from the fine river sand was of a very wet consistency. This sand was a fine quartz sand (100% passing a No. 20 sieve, and 82% retained on a No. 50 sieve, voids 41%, sp.gr. 2.66, and no silt). No appreciable amount of the water was taken up by the particles of sand themselves in this case.

It is my opinion that the major premise in Professor Williams' article is correct, that "the mortar test does not insure good concrete aggregate." My conclusion is drawn not from the results of our experiments, but from my experience with the technique of the mortar test itself. To be comparable, several mortars tested should be of the same consistency, and herein lies the difficulty. It is entirely a matter of judgment—or it is even more nearly true to say, a matter of guesswork—as to when a mortar is of the right consistency.

W. Purves Taylor proposes the formula

$$X = (3N + Sn + 1)/(4n + 4)$$

in which X = per cent of water for the sand-cement mixture, N = predetermined percentage of water to bring neat cement to normal consistency, n = parts of sand to one cement by weight, and S = a constant depending on the character of the sand and the consistency desired. The value of S for normal consistency for standard Ottawa sand is 25, and for bar and bank sands is from 27 to 33.

Applying this formula, using $N = 25\%$ and $n = 3$, we have

$S = 25$	$X = 9.43\%$
$= 27$	$= 9.81\%$
$= 33$	$= 10.9\%$

The extreme range of values of S for bar and bank sands here gives a difference of only 1.1% in the amount of water to use in the 1:3 mortar. In my opinion, the range of values of S requisite to a succesful application of this formula should be much greater. The use of the formula then would depend upon the selection of the proper value of S, which would not be any simpler than judging the consistency from the appearance of the mortar in the first place. It does not seem to me that it would be possible to devise a formula that would give correct results for sands of all characters. Therefore it seems to me that the test is a dangerous one and will lead to erroneous conclusions, except in the hands of a very highly skilled expert.

J. O. JONES,
Lawrence, Kan. University of Kansas.

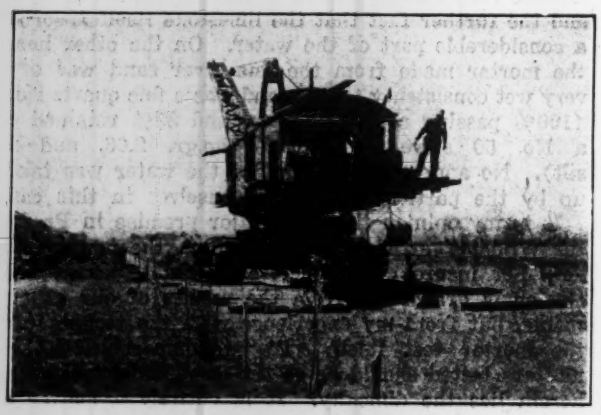
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Dragline Excavator Helps Itself to Fuel and Lays Track Over Soft Ground

BY J. E. BURKHOLDER
Drainage Engineer, United States Reclamation Service, Denver, Colo.

ON THE big drainage job of the Rio Grande irrigation project, described elsewhere in this issue, a number of caterpillar dragline excavators are used. The accompanying view shows the dragline helping itself to fuel. The machine stops its regular work just long enough to lift the oil drum and place it in a cradle. The drum is emptied into the fuel reservoir while the machine is in operation.



FUEL-OIL RESERVOIR FILLED WHILE DRAGLINE WORKS

Besides helping itself to fuel, the dragline lays its own track where needed over soft ground. The track is composed of 8 x 10-in. x 8-ft. timbers, strung on old wire cable. The same method of track-laying was used for crossing the Rio Grande River in shallow water, as shown in the view on the front cover and also on p. 547 of this issue.

Charging Off Depreciation on Contractors' Equipment

INSTEAD of the straight-line method of estimating depreciation on equipment, whereby a constant percentage of the first cost, dependent upon the probable length of life of the machine, is charged off each year, another plan of estimating depreciation is contained in a recent news letter of the Associated General Contractors of America. This plan was submitted by one of the association's members.

According to this contractor's method, the percentage charged off annually is based on the book value of the piece of equipment, so that normally the depreciation becomes less and less year by year, and the machine is always valued at some figure, until scrapped. However, the percentage adopted for any particular year will vary with the usage to which the equipment has been subjected, and one year it may be 30% and the next 20%. For example, a concrete mixer worth $3000 new might be carried on the contractor's books at $2100 after a year of hard service, and $1680 a year later if it was not used extensively the second year. By this method the greatest depreciation is considered to occur during the first year if the rate of usage of the mixer be constant.

This is consistent with the fact that when a new machine is used it immediately becomes second-hand equipment and usually loses considerable value if put up for sale.

There are advocates of this method of handling depreciation, on the ground that the depreciation charge plus the cost of repairs should be a constant value for each year that the equipment is in use, and, since repairs become heavier as the equipment becomes older, depreciation should decrease correspondingly. For the purpose of computing rental charges, however, difficulties are brought in by the assumption of a variable depreciation rate, since it is the average annual depreciation, after all, that would ordinarily be considered in fixing rentals.

In most cases where equipment is rented, the work is on a cost-plus basis and the fixed fee or percentage paid the contractor does not depend upon the rental of the equipment.

However, on some cost-plus work the rental charges are included in the sum on which the percentage is paid, and in such cases the rental rates quoted are reduced sufficiently to bring in approximately the same sum as when the profit fee is independent of the charges for use of equipment.

On lump-sum contracts, no attempt is made to carry equipment rentals on the payroll for the job. All charges against plant are handled in a separate account, and the proper share of the annual depreciation is charged to each contract.

Rental of equipment is paid for each calendar day between the date when the equipment is loaded at the storehouse of the contractor and the date that it is loaded for return. Transportation charges both ways and all current repairs are also included in the sum paid to the contractor for the use of equipment. Small tools, when new, are charged to the job and then taken back at a fair valuation when the contract has been completed.

Other Articles in This Issue of Interest to Contractors:

Drainage Works of the Rio Grande Irrigation Project Page 543
National Public-Works Department Versus Corps of Engineers Page 561
Two Home-Made Bridges in a Catskill Village Page 568

NEWS OF THE WEEK

New York, September 18, 1919

New Standards for Materials Adopted

Ten new standards have been adopted by the American Society for Testing Materials after letter-ballot vote, according to announcement from the society's office, 1315 Spruce St., Philadelphia, Penn. They include four specifications for brass (malleable castings, cartridge brass, cartridge-brass disks, and naval brass rods); two new standard tests (for flash point of volatile paint thinners and for apparent specific gravity of fine aggregate); three methods of test procedure (analysis of manganese bronze, analysis of gun metal, determination of softening point of bituminous materials); and recommended practice for laying sewer pipe. Two constitutional amendments voted upon at the same time were also carried.

Huge Oil Tank Fire Menaces Brooklyn

Starting Saturday, Sept. 13, and continuing well into Monday of the following week, a fire among the tanks of the Standard Oil Co.'s Kings County Refinery in Greenpoint, on the banks of Newtown Creek, just off the East River in New York City, for a time threatened serious extension into the adjoining Boroughs of Queens and Brooklyn. The origin of the fire has not yet been determined, but it was among a number of steel tanks which successively ignited with more or less explosion. At the time of going to press with this issue the plant was still in such condition as to prevent a thorough investigation of the origin or extent of the fire.

Bureau of Mines To Dedicate New Pittsburgh Laboratories

The Bureau of Mines, Department of the Interior, in coöperation with the Pittsburgh Chamber of Commerce, will dedicate its new $1,000,000 laboratories in Pittsburgh, Sept. 29-30 and Oct. 1. Dedication exercises will be held at 10:30 a.m., Sept. 29.

In the afternoon of Sept. 29 a special train will leave for the experimental mine near Bruceton. On the second day, contests will be held in mine rescue and first aid.

Duplicate Water-Works Refused in Pennsylvania

Permission to build a water-works plant that would duplicate the works of the Armstrong Water Co. has been refused the Borough of Kittaning, Penn., by the State Public Service Commission. The commission holds that a duplicate plant would be an "economic loss" as well as affording "more or less inadequate service" until one or the other works succumbed. The commission also declares that the company has not "performed its duty" and should immediately improve its works.

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 505 Pearl St.

Hearings Continued on Disposal of Army's Road-Building Plant

After listening to both sides of the controversy with regard to the use of the Army's surplus motor and other equipment for the building of state roads, the House Military Affairs Committee, in effect, told representatives of the War Department and of the Agriculture Department to harmonize their differences promptly and bring to the committee the draft of a bill to which each department would agree. There was no mistaking the temper of the committee in its instructions to the officials concerned to unite on a policy and express it in legislative form. It was also made clear that the draft of the legislation was expected soon.

Guy Hutchinson, representing the Director of Sales of the War Department, admitted frankly that the War Department preferred selling its equipment, at the highest possible price, to transferring it. It is safe to say that the majority of the members of the committee would not agree to such a policy. They are of the opinion that it would be better to turn this material over to the states than to sell it at bargain prices.

Senate Committee Reports Water-Power Bill

Changes From House Bill Mainly in Manner of Determining Reasonable Charge

(Washington Correspondence)

Admitting that some of the provisions of the water-power bill do not meet with its approval, the Senate Committee on Commerce, nevertheless, on Sept. 11, reported the bill favorably and urged that it be passed. The committee feels that the bill as reported is by far preferable to no legislation. The main changes made in the bill as it passed the House are thought to be ones with which the House conferees will agree, but it is not improbable that the opposition will be able to force various modifications of the measure as it now stands.

The most important amendment made by the Senate committee was that in which principles to govern the commission are laid down. The House bill simply provides that the licensee is to pay a reasonable annual charge such as may be fixed by the commission. The Senate committee believes that it is the duty of Congress to lay down these principles. This is especially necessary, it is declared, because the commission will be partisan and subject to frequent changes. For those reasons it was thought principles must be prescribed by Congress so as to insure at all times a stable public policy.

Fear that there might be interference with the rights of the states led some members of the committee to object to the provision of the bill requiring joint approval by the commission and by the state of contracts extending beyond the date of the termination of the license. The bill as amended leaves approval of such contracts entirely in the hands of the state.

The text of the amendment laying down principles for the commission reads as follows:

That the licensee shall pay for the license herein granted such reasonable annual charges as may be fixed by the commission, for the purpose of reimbursing the United States for the cost of administration of the act in relation to water powers developed under its jurisdiction, in the proportion that the water power developed by the project covered by said license bears to the total water power developed by all projects licensed under the act, and for that purpose such charges may be readjusted from time to time, not oftener than once in two years; the licensee shall also pay for the use and occupation of any public lands and lands in reservations except tribal lands embraced within Indian reservations necessary for the development of the project covered by the licence such reasonable annual charges based upon the actual value of the Government lands used as may be fixed by the commission; but in no event shall the annual charge for the foregoing exceed 25 cents per developed horsepower: Provided, that when licenses are issued involving the use of Government dams or other structures owned by the United States or tribal lands embraced within Indian reservations the commission shall fix a rea[illegible]

able annual charge for the use thereof, and such charges may be readjusted at the end of twenty years after the beginning of operations and at periods of not less than ten years thereafter in a manner to be described in each license.

Sewage-Works Conditionally Authorized for Phillipsburg, N. J.

Having previously disapproved plans for the Landreth "direct-oxidation" process of sewage treatment for Phillipsburg, N. J., the Pennsylvania State Department of Health, after remonstrance and special request by the town authorities, has passed a resolution stating that it will interpose no objection to the construction of a plant so long as it is considered experimental and the town agrees to make application for the approval of the plant and method of treatment stated after a year of operation. The original action was taken in March, 1919, the town then proposing that the sludge from the plant be discharged into the Delaware River.

The department disapproved of the application made by the town on Mar. 18, 1919, expressing the belief that "the same degree of purification can be secured at less expense by other established methods."

After several hearings at which representatives of the town urged that they had observed the operations of a demonstration plant of the proposed type at Easton, were satisfied that the process was the most economical method for the town to adopt, and urged that the town be allowed to assume responsibility for selecting a method of disposal, especially in view of the fact that the department always reserves the right to require additional treatment if a plan adopted for the treatment of sewage is not satisfactory, the department, Aug. 18, 1919, adopted the following resolution which is reprinted here in full:

Whereas, The State Department of Health has been unable to secure sufficient information regarding the efficiency of the direct-oxidation or "Landreth" method for the treatment of sewage to enable it to definitely determine at this time whether this process can be depended upon to treat sewage successfully at a reasonable cost, but from the information now available, however, the department is of the opinion that substantially the same results can be secured by the use of lime alone at a lesser cost, be it therefore

Resolved, that if the inhabitants of the Town of Phillipsburg are desirous of installing a plant for the treatment of sewage by this method, this department will interpose no objection for the construction of such a plant as an experimental installation and its operation for a period of one year, provided:

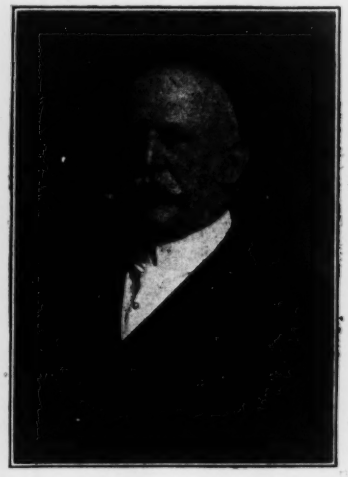
1. That no sludge from said plant be discharged into the Delaware River or its tributaries at any time, and that a settling period of six hours, based upon the average sewage flow, shall be provided for the lime-electric treated sewage.

2. That adequate laboratory facilities be provided and that a sufficient number of routine chemical and bacterial tests be made by the Town of Phillipsburg under the supervision of this department; and that at the expiration of one year from the date when the plant is put into operation the inhabitants of the Town of Phillipsburg may make application for the approval of this method of sewage treatment.

Under the resolution new plans will have to be filed with the Pennsylvania Department of Health.

C. M. Jacobs, Tunnel Engineer, Dead

Charles M. Jacobs, an engineer of wide note in the field of subaqueous tunnel construction and member of the New York firm of Jacobs & Davies, consulting engineers, died in London, England, Sept. 7, at the age of 69 years. An Englishman by birth, Mr. Jacobs, after extensive practice in England, came to the United States at the request of the late Austin Corbin, president of the Philadelphia & Reading R.R., to advise on designs for rapid-transit tunnels between Brooklyn, New York and Jersey City. He maintained a practice as consulting engineer in New York City for several years, being at first retained by the Long Island R.R., the New York & New England Railroad Co., and the Elmira, Cortlandt &



CHARLES M. JACOBS

Northern Railroad Co. In 1892 and 1893, as chief engineer, he designed and built the tunnel under the East River for the East River Gas Co., a project which presented formidable construction difficulties. Later, as chief engineer for the New York & Long Island Construction Co., he designed and constructed foundations for the piers of the bridge over Blackwell's Island, and as chief engineer for the New York-New Jersey Railroad Co. carried on construction of the tubes between Jersey City and Morton St., New York City.

Later he was engaged by the Pennsylvania R.R. as chief engineer of the North River division; by the Pennsylvania, New York & Long Island Railroad Co., and as a member of the board of engineers of the Pennsylvania and New York Tunnel Lines.

Mr. Jacobs was born in Hull, Yorkshire, in 1850. After studying at Cambridge University he obtained his practical knowledge of engineering in the shop of Charles and William Earle, engineers and shipbuilders of Hull. After being with his employers five years, Mr. Jacobs saw service at sea for the next two years, and then acted as the superintending engineer in charge of construction of two steel steamships for the Florio Co. and Moran Steamship Line. He then embarked in private practice as a consulting engineer in Cardiff, South Wales, engaging in marine work, construction of dry docks and subaqueous construction work. Prior to his coming to the United States Mr. Jacobs was in consulting work in London, being a member of the firm of Jacobs & Barringer.

When Mr. Jacobs severed his connection with the Pennsylvania R.R. as chief engineer of the North River division, he had attained the record of building six tunnels under the Hudson River, the North River tunnel and the Berger Hill tunnel being practically complete at the time he left. Perhaps most notable in his tunnel construction work here was the pioneer project built for the East River Gas Co. That tunnel was built between Ravenswood, L. I., and E. 71st St., New York City. The tunnel was driven simultaneously from both sides of the East River, and the headings met July 11, 1894.

Besides his work in New York City and London, Mr. Jacobs served, on several occasions, the French Government and French private concerns, designing tunnels for the Metropolitan Ry. under the Seine at Paris.

House Passes Bill to Limit Height of Washington Buildings

Without a dissenting vote or an important amendment, the House of Representatives passed the bill to regulate the height, area and use of buildings in the District of Columbia. The bill also provides for the creation of a zoning commission. The chief objection to the measure was that the bill pays too much attention to the interests of the builder and too little attention to the interests of the public. In presenting the bill for discussion Representative Mapes, chairman of the District of Columbia Committee, pointed out that the bill is patterned after the New York and the St. Louis zone laws.

The zoning commission in Washington is to consist of the three Commissioners of the District of Columbia, the officer in charge of public buildings and grounds of the District of Columbia, and the superintendent of the capitol building and grounds.

Additional Appropriation for the Alaska Railroad

The House of Representatives has voted an additional appropriation of $17,000,000 to complete the construction of the Alaska Government R.R. between Seward and Fairbanks, for which the original appropriation was $35,000,000. The road is now completed for a distance of approximately 227 miles on one end and 100 miles on the other end, with a gap of 144 miles.

Status of Railroad Technical Engineers' Salaries

Following the hearing, before the Board of Wages and Working Conditions, of representatives of Engineering Council and the American Association of Engineers, in regard to the matter of raising the compensation of technical engineers employed by the United States Railroad Administration, which hearing was held in Washington, Mar. 31—Apr. 1-2, 1919, as reported in *Engineering News-Record* of Apr. 10, 1919, p. 742, progress has been made towards adjustment, but as yet no final settlement has been reached.

The case was taken out of the hands of the Wage Board by the director of the Division of Operation, and transferred to the regional directors. As last reported the situation was:

Northwestern Region (R. H. Aishton, regional director)—Matter referred to committee of three of the chief engineers after the regional director had called a conference of all of the chief engineers. Committee made recommendations to the regional director, which, on the whole, were satisfactory to the engineers. Recommendations approved by regional director and increases granted.

Central Western Region (Hale Holden, regional director)—Position taken by regional director that matter is one for individual action by the Federal managers; engineers have protested to the Division of Operation.

Southwestern Region (B. F. Bush, regional director)—Only minor adjustments in engineers' salaries have been made, some as a result of the general order for increases in railroad wages; engineers have presented additional data to the Regional Director, renewing request for further attention to matter.

Allegheny Region (C. H. Markham, regional director)—Engineers do not find that any action has been taken in this region and have appealed to the Division of Operation.

Southern Region (B. L. Winchell, regional director)—Adjustments satisfactory to engineers have been made on several of the roads in this region, and in general only isolated cases are now being taken up.

Eastern Region (A. T. Hardin, regional director)—Matter has been taken up in conference with chief engineers, but as yet only small increases in individual cases have been granted. Engineers are appealing personally to the chief engineers, in addition to formal action being taken.

San Francisco Drops 77 Engineers From City's Payroll

The appropriations for carrying on the work of the Engineering Department of San Francisco in the coming fiscal year has been so curtailed by the Board of Supervisors that the City Engineer found it necessary to dismiss 77 employees. Notification of dismissal, which was made Sept. 8 to take effect at the close of the day, went to 12 assistant civil engineers, one supervising assistant civil engineer, 15 engineering draftsmen, four surveyors, 18 field assistants and 27 inspectors of streets and sewers.

In reply to an appeal made directly to the Supervisors on behalf of the men affected, the chairman of the finance committee said: "We have made our appropriations and the tax levy is to all intents passed, so we cannot now revise it. We have allowed the engineer's staff money for all regular work and provided for the union scale of wages." He also pointed out that no funds were available for pioneering work, for surveys and studies of new projects.

High Water Again Floods North Side of Galveston

For the second time since the flood of 1900 which practically destroyed the city, a part of Galveston, Tex., was flooded Sept. 14 by the rising water in the Gulf, driven northward by a tropical hurricane. Fortunately for the city, the sea wall, built after the 1900 disaster, and the accompanying grade elevation on the south side of the island, prevented a repetition of the catastrophe, but the north side of the island, which is still at the low level, was flooded to the depth of 3 to 6 ft. The flood was slow-rising and not violent, so that what damage was done was due to water soaking. It soon passed off.

The flood, however, makes timely a reference to the proposed grade-elevation work on the north side of the island. Up to about the east and west center line of the city, the grade has been raised to some 21 ft. above the sea level, but the north side still is low, as may be inferred from the present flood. A municipal grade-raising committee last spring employed J. B. Lippincott, consulting engineer, Los Angeles, to study the subject of grade raising. He presented various reports, recommending a graduated scheme of improvement. The amount of work involved depends on the area covered by the improvement. If all that section of the city roughly described as lying north and west of the sea wall south of the bay and east of 40th Street, excluding the railway yards, is considered as being raised as recommended to an elevation of 15½ ft., the present elevation being about 6½ ft., at the north or bay front, rising with a grade of 1 ft. in 1600 to the south, to an elevation of approximately 21 ft. at the sea wall, it would involve the placing of about 20,000,000 cu.yd. of fill. It is thought that the present flood may hasten the consideration of the grade-elevation scheme.

The same hurricane apparently entered west of Galveston, approximately at Corpus Christi. Here the damage was very serious, though full reports are not yet available. It is reported, however, that the deaths in the district total 25 and property loss is $4,000,000.

Contributions From Engineers, Architects and Constructors' Conference on National Public Works

M. O. LEIGHTON, Chairman

PUBLISHER'S NOTE: *The space occupied under this caption is donated to serve as a means of frequent and intimate communication between the Engineers, Architects and Constructors' Conference on National Public Works, and the members of the profession. The contributor takes full authority for the statements made.*

It appears desirable to explain certain points in the Jones-Reavis bill, providing for the creation of a national Department of Public Works, which have puzzled readers who are not in touch with the present legislative and departmental situation in Washington.

Why do we propose to transform the Department of the Interior instead of creating a new one?

Because (a) there are already enough executive departments to perform Government business if the functions were properly correlated; (b) because there is a natural reluctance on the part of Congress to create new departments, which of itself would be an enormous handicap to any public-works legislation.

Why do we propose that the present Secretary of the Interior shall continue as Secretary of Public Works until he shall go out of office?

Because the present Secretary is a very able man and he has had more than seven years of intensive training in the administration of the office of Secretary of the Interior.

Why do we propose to maintain in the present organization of the Interior Department and its bureaus, except those designated for separation, and transfer other bureaus from other departments thereto without change of organization?

Because (a) no one is wise enough at present to make a decision as to the best reoganization plan; (b) because the best reorganization will be that achieved gradually as the result of experience within the new department; (c) because a large degree of reorganization can lawfully be made by executive order; (d) because when, after experience has been secured, special reorganization legislation becomes necessary, a bill can be presented to Congress reinforced by such experience and have the prestige of a going department behind it.

What remains in the Department of the Interior as a nucleus of the Department of Public Works after the six bureaus designated in Sec. 3 of the bill have been removed?

The General Land Office, the Geological Survey, the Reclamation Service, the Bureau of Mines, the National Park Service, and the Alaskan Engineering Commission.

Why do we propose to assign the various nonengineering bureaus of the Interior Department to the places designated in the bill?

We do not claim any particular qualifications that enable us to choose the wisest assignments of these bureaus. We were obliged to put them somewhere in order to round out the bill, and we used our best judgment. Others, better qualified than we, will undoubtedly have something to say when the bill comes to consideration in committee of Congress.

Why do we propose to transfer the jurisdiction over rivers and harbors from the War Department?

Because, entirely aside from the decidedly adverse opinions that the great body of engineers entertains as to the fitness of the Corps of Engineers, U. S. A., and its past performances, rivers and harbors improvements for navigation constitute a purely civil function which is merely one phase of our rivers and harbors development and utilization, and the whole cannot go forward effectively, considerately and economically without thorough coördination. Navigation improvements are public works and are so defined world over, and the fact that in an early day in the history of our republic they were placed under the Corps of Engineers, as a purely emergency measure, which has since been continued by well directed influence and legislative inertia, constitutes not the slightest reason why an illogical arrangement should be perpetuated.

Why do we propose that members of the Corps of Engineers, U. S. A., should be detailed to duty under the Department of Public Works?

Because the members of the Corps of Engineers rightfully contend (and this is the only substantial argument so far brought forward by the corps against a Department of Public Works) that the Army must maintain an Engineer Corps on a basis suitable for war emergency; that so large a corps will not be required on purely military duties in peace time and that in the absence of some engineering assignments of another character the Corps of Engineers will "rust out." The provision in the bill, therefore, provides for this contingency. It places the engineers in the Army under assignments suitable to their training and experience, and makes no change in their professional status, except that it establishes the principle, which appears to be good American doctrine, that because a certain group of men is educated at public expense and accorded military titles, it does not follow that they must become hereditary superiors to other men in engineering life. The members of the Corps of Engineers in their civilian work would, under the provisions of this bill, stand on a common footing with civilian engineers and indulge in a very healthful competition for relative position in the engineer work of the Government, and attain such by reason of actual performance rather than by seniority of military grade.

Why do we propose to include the Construction Division of the Army in the Department of Public Works?

Because (a) this division is made up almost entirely of civilian engineers highly experienced in construction work, who have, in connection with the war emergency, performed the most extensive and remarkable achievements in engineering construction ever performed by any one organization in the history of the country; (b) because it has worked out a most effective plan of organization and operation which is in a large degree responsible for the results achieved and which could be amalgamated most efficiently with many of the peace-time construction operations of the Government; (c) because the War Department has not provided for the perpetuation of this organization, as such, in its plan for a new military establishment, which is now the subject of investigation by Congress, and, at least by inference, proposes to allow the Construction Division to lapse or to merge its functions with certain old-line military departments where it will be in an environment entirely foreign to the spirit and practice which have caused it to be so unqualified a success; (d) because the construction work which this division has accomplished is for the most part not military engineering at all, and the only military significance which it has is derived from the subsequent utilization thereof for military purposes. There is no more reason why the construction of a warehouse, a depôt or a dock for the Army cannot be executed by an established construction organization not connected with the Army than there is for the contention that a Federal courthouse should be constructed by the Department of Justice instead of, as in the past, by the Supervising Architect's Office of the Treasury; (e) because when the United States entered the great war it was necessary to organize the Construction Division in an extreme emergency attended by costly delay, and there should be an active, going construction organization in the service of the Government, which in the case of a future war could be made to function at an instant's notice as a construction branch of the military establishment. The only way by which this can be accomplished is to have such an organization in active practice in peace-time work.

Street Car Subway Project Held Up

No progress has been made in working out the street-car subway project in Pittsburgh, Penn., since its authorization by a favorable bond-issue vote of the citizens two months ago. The city administration is delaying further study of the construction and operating plans until the present receivership of the street-railway company is settled.

Civil Service Examinations

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Assistant examiner, Patent Office, Washington, D. C., $1500 to $1740 per year, Sept. 17 to 19 and Nov. 19 to 21. File applications in time to arrange for examination at place selected by applicant.

Senior highway engineer, Bureau of Public Roads, Department of Agriculture, $2220 to $4000 per year, Oct. 21. File applications before Oct. 21.

Engineer, $3000 per year; assistant engineer, $1800 to $2880 per year; junior engineer, $1200 to $1740 per year; engineering draftsman, $1200 to $3000 per year, Reclamation Service. Applications will be received until further notice.

ENGINEERING SOCIETIES

Calendar

Annual Meeting

NEW ENGLAND WATER WORKS ASSOCIATION; Tremont Temple, Boston, Sept. 30, Oct. 1-3, Albany, N. Y.

NATIONAL SAFETY COUNCIL, 168 Michigan Ave., Chicago; Oct. 1-4, Cleveland.

AMERICAN SOCIETY OF NAVAL ENGINEERS: Secretary, Lieut. Com. F. W. Sterling, U.S.N., Navy Department, Washington, D. C.; Oct. 7, Washington.

AMERICAN PUBLIC HEALTH ASSOCIATION: 169 Massachusetts Ave., Boston; Oct. 27-30, New Orleans.

CITY MANAGERS' ASSOCIATION, 1812 Tribune Bldg., New York City; Oct. 29-31, Indianapolis.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS; 304 E. Walnut St., Bloomington, Ill.; Nov. 11-14, New Orleans.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS; 29 W. 39th St., New York City; Nov. 13, New York City.

The Sacramento Chapter of the **American Association of Engineers** was formally installed by F. H. Newell, president of the association, on Aug. 25. Threescore of Sacramento's engineers joined in the banquet and listened with interest to President Newell's story of the American Association of Engineers. Action was taken urging upon Governor Stephens the appointment of an engineer to fill the vacancy in the State Water Service Commission.

The Twin City Chapter, American Association of Engineers, has appointed

a committee to investigate and recommend salary schedules for employees of city departments in Minneapolis and St. Paul. Legislation in which the society is interested includes the Townsend bill, now before Congress, and that affecting the United States Patent Office. At the regular meeting Sept. 5 members listened to a talk on the construction of the Gièvres depot, built by A. E. F. engineers.

The **Spokane Engineering and Technical Association** has recently changed its name to the **Associated Engineers of Spokane, Wash.**

The **Globe-Miami Chapter of the American Association of Engineers** recently entertained President Newell of the association, on his return through Arizona from his visit to Pacific Coast chapters.

The **Washington Chapter of the American Association of Engineers** has undertaken the distribution of questionnaires among technical engineers in the Government service, with the idea of obtaining information of value to the Joint Congressional Commission on the Reclassification of Salaries in the District of Columbia. A special committee from the Washington Chapter is cooperating with the reclassification commission in drawing up definitions of the various classes of engineering jobs in the Government service.

The **Indianapolis Chapter of the American Association of Engineers** has adopted a resolution asking that in the future county highway inspectors receive all of their compensation from the state, instead of half from the county and half from the Portland Cement Association. The resolution states that it is contrary to public policy for county employees to receive a part of their compensation from outside sources.

The **North Carolina Society of Civil Engineers** has voted to proceed with consolidation with the American Association of Engineers and to carry out the affiliation as soon as the committee appointed to conduct the negotiations has completed its work. The president of the society is Dr. W. C. Riddick, president of North Carolina State College.

The **Colorado Chapter of the American Society of Civil Engineers** held its 105th regular meeting Sept. 13. An application of the methods of draining and sealing porous foundations and abutments of high dams by means of cement under high pressure, as applied to the Beaver Park dam on the Rio Grande River, was the subject of the discussion that was led by **M. C. Hinderlider.**

The **Engineers' Society of Milwaukee,** at its regular monthly meeting, Sept. 17, listened to an illustrated talk on "The Physics of Boiler Circulation," by Dr. Edgar Kidwell, author of "Sterling." Dr. Kidwell is an authority on steam production.

PERSONAL NOTES

COL. ELBERT A. GIBBS, recently returned from more than two years' service in France with the American Expeditionary Forces, has been promoted to be general manager of the McClintic-Marshall Co., Pittsburgh. Prior to his entry into the Army, Colonel Gibbs was manager of erection of the company's Western district. He was commissioned Captain, Engineers, in 1917, and was among the first engineer officers to arrive in France. He quickly demonstrated his capacity for large responsibilities and was promoted successively to the rank of colonel, being among the comparatively few engineer officers who entered the service from civil life to reach that grade. Colonel Gibbs was the chief of the general construction section of the Division of Construction and Forestry, Office of the Chief Engineer, A. E. F., reporting directly to Brig. Gen. Edgar Jadwin. In this capacity he was responsible for the large programs of barracks, hospital and warehouse construction throughout the Services of Supply, in addition to having supervision over the subsections handling gasoline and oil storage, refrigeration, water-supply and sewerage, and electric installations. Among other forms of recognition of his services in the A. E. F., Colonel Gibbs received the decoration of Officer of the Legion of Honor from the French Government.

A. J. CLEARY, formerly second assistant city engineer of San Francisco, has been appointed first assistant to M. M. O'Shaughnessy, city engineer, by the Board of Public Works, which accepted the resignation of H. W. SHIMER. C. E. HEALY has been promoted to second assistant city engineer.

H. FRED STARKS, county engineer of Nassau County, New York, has been reappointed for another four-year term by the county board of supervisors.

W. H. LOWTHER has been appointed division engineer on the Kansas division of the Union Pacific R.R., with office at Marysville, Kan. He was formerly division engineer on the Oregon Short Line Railroad.

MAJ. GILBERT G. JACOBOSKY, Engineers, U. S. A., has been discharged from the service after more than a year in France, and has resumed his practice as consulting civil engineer in Wilkes-Barre, Penn. Major Jacobosky expects to open a New York office in the near future.

CLINTON COWEN, for the past four and a half years state highway commissioner of Ohio, resigned Sept. 9, and has accepted a position as consulting engineer for the National Sand and Gravel Association. He will assume his new duties Jan. 1. A. R. TAYLOR, former county surveyor of Hancock County, has been appointed to fill the vacancy caused by Mr. Cowen's resignation.

D. W. WEBSTER, for several years highway engineer of Lyon County, Minnesota, has resigned to accept a position with the state as division engineer of the northwest section. ARTHUR BLADHOLM succeeds him.

COL. H. A. ALLEN, U. S. A., Chicago, a former member of the Panama Canal Commission, who recently returned from service overseas, has been retained as engineer by the Dixie Power Co. in the development of the resources of White River, Arkansas, where the company plans to develop from 80,000 to 100,000 horsepower.

RODMAN WILEY, formerly commissioner of public roads of Kentucky, has resigned to become chief engineer of the Kentucky Rock Asphalt Co., Louisville, Ky. He has been connected with the Public Roads Department since 1914, and was appointed commissioner in 1916.

MAYO TOLMAN, former director and chief engineer of the West Virginia State Department of Health, has resigned. His resignation became effective Sept. 1.

E. A. VAN DEUSEN, after seven years with the Southern Power Co. and affiliated interests in New York and Charlotte, N. C., has resigned to accept a position as structural and hydraulic designer with the Fargo Engineering Co., Jackson, Mich.

CAPT. E. C. DOHM, U. S. A., who served with the United States engineers overseas, has resumed his position as chief engineer of the land commissioner's office at Olympia, Wash.

MAJ. CARL H. REEVES, U. S. A., for 23 months in the Engineer Corps, has announced his return to private practice Oct. 1, and will open offices in the Henry Bldg., Seattle. For several months he has been connected with Parker, Gould & Company.

ELLIS S. TISDALE has been appointed director and ANDREW N. WARDLE chief engineer, respectively, of the West Virginia State Department of Health, both of which positions were filled by MAYO TOLMAN, resigned, as noted elsewhere in these columns. Both Mr. Tisdale and Mr. Wardle have served three years as assistant engineers in the State Department of Health.

W. M. STRONG, hydro-electric and mining engineer of Denver, Colo., has located his office in the Alaska Bldg., Seattle, for private practice.

H. A. ROBERTS has been appointed division engineer on the Idaho division of the Oregon Short Line R.R., with office at Pocatello, Idaho. He succeeds W. H. LOWTHER, resigned.

WALTER M. SMITH, formerly designing engineer of the Miami Conservancy District, has resigned that position to become chief designing en-

gineer of the Illinois Waterway, Department of Public Works and Buildings, State of Illinois. In his new position Mr. Smith will have charge of design of all structures on the Illinois Waterway, which is to connect the lower end of the Chicago Drainage Canal with the head of navigation on the Illinois River at Utica.

F. B. COPE, formerly of Pittsburgh, Penn., has entered the private practice of general engineering and construction work, with office at Salem, Ohio.

FRANK B. ROTH, Philadelphia, has accepted the position of chief engineer of the Lehigh Structural Steel Co., Allentown, Penn. He was formerly president of the Philadelphia Chapter of the American Association of Engineers.

H. W. HOUGHTON has resigned from the engineer department of the Kansas City Southern R.R., at Pittsburg, Kan., to become associated with the Nebraska State Highway Engineering Department as designer. His headquarters will be at Lincoln.

GLENN I. VOYLES, former county engineer of Phillips County, Kansas, has been appointed county engineer of York County, Nebraska.

A. M. SCHOTT has been appointed city engineer of Sioux City, Iowa, vice T. H. JOHNSON, who resigned recently to enter private practice as noted in *Engnneering News-Record* of Aug. 21, 1919.

PROF. W. K. HATT, head of the School of Civil Engineering, Purdue University, who has been on leave of absence since Jan. 1, 1919, has resumed his former duties.

G. A. MANEY, who, before becoming affiliated with the Emergency Fleet Corporation, was a member of the faculty of the University of Minnesota, has severed his connection with the Corporation and returns to Minnesota to become assistant professor of structural engineering.

CAPT. LOUIS R. JOHNSON, U. S. A., who has been serving overseas with the Army Engineer Corps, has returned to his home in San Diego, Calif., to resume his practice.

OBITUARY

GEORGE F. LEAVENWORTH, for some years a mining engineer with the Tennessee Copper Co., died recently at Ducktown, Tenn. Mr. Leavenworth was a graduate of the University of Vermont, and had been engaged during the greater part of his professional career in railroad location and construction work and the location and construction of street railways. Several years ago he engaged in mining operations in the South.

BUSINESS NOTES

H. K. DAVIES, formerly with Wallace & Tiernan Co., Inc., New York City, recently entered the employ of the Pennsylvania Salt Manufacturing Co., Philadelphia, Penn. Mr. Davies will be concerned with the development of the uses of liquid chlorine.

THE NITZBERG & WEITZNER CO., INC., engineer, builder and contractor, has recently been incorporated for the purpose of planning and executing all forms of engineering and general building construction work. Offices have been opened in the Woolworth Bldg., New York City.

THE DUNBAR MFG. CO., 5133 W. Lake St., Chicago, manufacturer of railway and automobile supplies, has appointed W. C. Irwin as district sales representative in St. Louis and the Southwest, with offices in the Frisco Bldg., St. Louis, Mo. Mr. Irwin has represented several railway supply companies. During the war he was a captain in the Engineer Corps, United States Army.

THE BUCYRUS CO., South Milwaukee, Wis., has opened a Cleveland, Ohio, office at 808 American Trust Bldg., is in charge of E. G. Lewis, formerly of the New York office of the company and more recently president of the New Jersey Slag Products Co., Dover, N. J.

THE WORTHINGTON PUMP & MACHINERY CORPORATION, 115 Broadway, New York City, has purchased the plant and other assets of the Epping-Carpenter Pump Co., of Pittsburgh, Penn., and will operate the same as the Epping-Carpenter Works. Orders and contracts now in hand will be completed, and the regular business of the company will be continued. All correspondence should be addressed to the Worthington Pump & Machinery Corporation at the Epping-Carpenter Works, 10 Forty-third St., Pittsburgh, Penn.

THE WILLIAMSPORT WIRE ROPE CO., Williamsport, Penn., has established a branch office and warehouse in Chicago, Ill., under the direction of C. M. Ballard, formerly connected with the organization, in Cleveland, Ohio. The office is located at 122 S. Michigan Ave., from which location the business in the Middle West will be handled. A complete line of the wire rope of various sizes manufactured by the company will be carried at the warehouse.

THE AMERICAN SEWER PIPE CO., 15 Broad St., Akron, Ohio, announces a change of its corporate name to the AMERICAN VITRIFIED PRODUCTS CO. This was thought advisable, as the company is now manufacturing a varied line of vitrified-clay products other than sewer pipe. The management and the location of the general and the branch offices remain unchanged.

TRADE PUBLICATIONS

The following companies have issued trade publications:

THE BLAW-KNOX CO., manufacturer of steel products, Pittsburgh, Penn.; Bulletin No. 200, 6 x 9 in., 16 pages, illustrated; contains information regarding the use of automatic single-rope cableways.

THE GEORGE C. VIDETTO MACHINERY CO., Bessemer Bldg., Pittsburgh, Penn.; folder, 9 x 12¼ in., eight pages, illustrated, and leaflet, 8½ x 11 in., two pages, illustrated; the folder describes concrete mixers, belt conveyors, elevating loaders, stone crushers, revolving screens, etc., and the leaflet pertains to the subject of standard bucket elevators.

THE O. K. CLUTCH & MACHINERY CO., Columbia, Penn.; Catalog No. 19, 8 x 11 in., 24 pages, illustrated; describes and gives ratings of hoisting machinery.

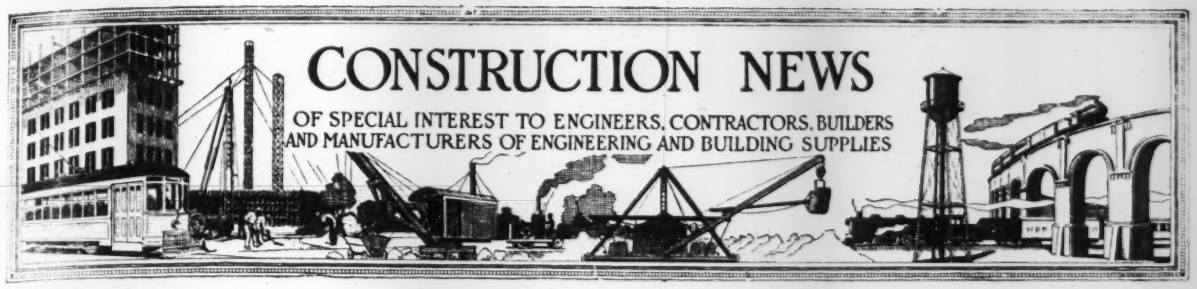
THE AMERICAN STEAM CONVEYOR CORPORATION, Chicago and New York; folder, 9½ x 16 in., four pages, illustrated; describes method of ash disposal by means of a steam ash conveyor.

"ASBESTOS" is the name of a new monthly trade publication, issued in the interests of the asbestos and magnesia industries, by Secretarial Service, 721 Bulletin Bldg., Philadelphia, Penn. It is in booklet form, 5 x 7½ in., and contains about 28 pages, including advertisements. It aims to furnish common ground where those interested in asbestos and magnesia may meet for discussion of their common interests and problems.

THE JEFFREY MANUFACTURING CO., manufacturer of coal-mining machinery, electric locomotives, etc., Columbus, Ohio; Bulletin No. 270, 7½ x 10½ in., eight pages, illustrated; descriptive of ventilating fans, giving tables of dimensions and capacities; particular emphasis is put on the subject of mine ventilation.

THE ALLIS-CHALMERS MANUFACTURING CO., Milwaukee, Wis.; Bulletin No. 1456, 7¾ x 10½ in., 19 pages, illustrated; descriptive of revolving roll rock crushers with both removable and fixed teeth.

THE MONIGHAN MACHINE CO., 2016 Carroll Ave., Chicago; Catalog No. 19, 8½ x 11 in., 46 pages, illustrated; pertains to walking dragline excavators, and dragline machines mounted on rollers and skids; the illustrations show the mechanical construction and numerous views of the machines at work.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

"For Proposals Advertised see the pages immediately following the Construction News Section."

WATERWORKS

Bids Close		See Eng. News-Record
Sept. 22	Chadron, Neb.	Sept. 11
Sept. 22	Judith Gap, Mont.	Sept. 18
Sept. 24	Marcy, N. Y. Adv. Sept. 11.	Sept. 11
Sept. 25	Hamtramck, Mich.	Sept. 18
Sept. 29	Flagley, Colo.	Sept. 18
Sept. 30	Detroit, Mich.	Sept. 11
Oct. 2	East Hartford, Conn. Adv. Sept. 11.	Sept. 11

SEWERS

Sept. 22	Wilbur, Neb.	Sept. 11
Sept. 22	Judith Gap, Mont.	Sept. 18
Sept. 22	London, Ont.	Sept. 18
Sept. 23	Broken Bow, Neb.	Sept. 11
Sept. 24	Elkhorn, Wis.	Sept. 18
Sept. 24	Phillipsburg, N. J. Adv. Sept. 18.	Sept. 18
Sept. 26	Virogua, Wis.	Sept. 18
Oct. 1	Baldiwn, Pa.	Sept. 18

BRIDGES

Sept. 22	Norristown, Pa. Adv. Aug. 28.	Aug. 28
Sept. 22	Duluth, Minn.	Sept. 11
Sept. 23	Harrisburg, Pa. Adv. Aug. 14.	Aug. 14
Sept. 23	Harrisburg, Pa.	Sept. 11
Sept. 24	Lexington, N. C.	Sept. 11
Sept. 24	Fredericton, N. B.	Sept. 18
Sept. 24	Ebensburg, Pa.	Sept. 18
Sept. 26	Kenosha, Wis. Adv. Sept. 18.	Sept. 18
Sept. 29	Birmingham, Ala.	Sept. 18
Sept. 29	Iola, Kan.	Sept. 18
Sept. 29	New Jersey Adv. Sept. 11.	Sept. 11

STREETS AND ROADS

Sept. 22	Chicago, Ill.	Sept. 18
Sept. 22	Lyons, Kan.	Aug. 28
Sept. 22	New York, N. Y.	Sept. 18
Sept. 22	California	Sept. 18
Sept. 23	Keyser, W. Va. Adv. Sept. 4.	Sept. 4
Sept. 23	Peru, Neb.	Sept. 11
Sept. 23	Beaver City, Neb.	Sept. 11
Sept. 23	Keyser, W. Va.	Sept. 11
Sept. 23	Athens, Ga. Adv. Sept. 11.	Sept. 11
Sept. 23	Philadelphia, Pa.	Sept. 11
Sept. 23	Salisburg, Md.	Sept. 11
Sept. 23	Massachusetts	Sept. 11
Sept. 23	Ralston, Neb.	Sept. 18
Sept. 24	Lexington, Neb.	Sept. 11
Sept. 24	Elwood, Neb.	Sept. 11
Sept. 24	Ebensburg, Pa.	Sept. 18
Sept. 24	Manitowoc, Wis.	Sept. 11
Sept. 24	Brooklyn, N. Y.	Sept. 18
Sept. 24	Marcy, N. Y.	Sept. 18
Sept. 25	Kimbal, Neb.	Sept. 11
Sept. 25	North Bergen, N. J.	Sept. 11
Sept. 25	St. George, S. I., N. Y.	Sept. 18
Sept. 25	Mt. Clemens, Mich.	Sept. 18
Sept. 25	Duluth, Minn.	Sept. 18
Sept. 25	Louisiana	Sept. 18
Sept. 25	Concord, N. C.	Sept. 18
Sept. 26	North Carolina	Sept. 18
Sept. 26	Loup City, Neb.	Sept. 11
Sept. 27	Aitkin, Minn.	Sept. 11
Sept. 30	Pennsylvania Adv. Sept. 11.	Sept. 11
Sept. 30	Blackfoot, Idaho	Sept. 11
Sept. 30	Montgomery, Ala. Adv. Sept. 18.	Sept. 18
Oct. 1	Faribault, Minn.	Sept. 4
Oct. 2	Madison, W. Va.	Sept. 11
Oct. 2	Trenton, Ga.	Sept. 18
Oct. 6	Rideway, Mo.	Sept. 18
Oct. 6	Ft. Scott, Kan.	Sept. 18
Oct. 6	Fayetteville, W. Va. Adv. Sept. 18.	Sept. 18
Oct. 7	Montevideo, Minn.	Sept. 18
Oct. 7	Billings, Mont.	Sept. 18
Oct. 10	Tacoma, Wash. Adv. Aug. 14.	Aug. 14
Oct. 11	Brainerd, Minn.	Sept. 18
Oct. 13	Lancaster, Mo.	Sept. 11

EXCAVATION AND DREDGING

Sept. 21	Sheboygan, Wis.	Sept. 18
Sept. 22	Tower, Minn.	Aug. 21
Sept. 22	New York, N. Y.	Sept. 11
Sept. 22	Duluth, Minn.	Sept. 4
Sept. 23	Marianna, Ark.	Sept. 18
Sept. 23	St. John, N. B.	Sept. 18
Sept. 26	Colusa, Cal.	Sept. 18
Sept. 29	Waseca, Minn.	Sept. 11
Oct. 4	Greenfield, Ind.	Sept. 18
Oct. 7	Olivia, Minn.	Sept. 18

INDUSTRIAL WORKS

Sept. 20	New York, N. Y.	Sept. 11
Sept. 24	Melville, Sask.	Sept. 18
Sept. 27	Cap de la Madeleine, Que.	Sept. 18
Sept. 27	Edgerton, Wis.	Sept. 18
Oct. 7	Marcy, N. Y. Adv. Sept. 18.	Sept. 18

BUILDINGS

Sept. 22	Holton, Kan.	Sept. 4
Sept. 22	San Francisco, Cal.	Sept. 11
Sept. 22	Eldorado, Kan.	Sept. 11
Sept. 22	Toronto, Ont.	Sept. 11
Sept. 22	New York, N. Y.	Sept. 13
Sept. 22	Bridgeport, Conn.	Sept. 18
Sept. 22	Balaton, Minn.	Sept. 18
Sept. 22	Willimantic, Conn.	Sept. 13
Sept. 22	Hartford, Wis.	Sept. 18
Sept. 23	Bessemer, Ala.	Sept. 18
Sept. 24	Selkirk, Man.	Sept. 11
Sept. 25	Brooklyn, N. Y.	Sept. 11
Sept. 25	Moncton, N. B.	Sept. 4
Sept. 25	Charlevoix, Mich.	Sept. 13
Sept. 25	Redding, Conn.	Sept. 18
Sept. 26	Worcester, Mass.	Sept. 18
Sept. 27	Clintonville, Wis.	Sept. 18
Sept. 29	Ankeny, Ia.	Sept. 18
Sept. 30	Salt Lake City, Utah	Sept. 11
Sept. 30	Biwabik, Minn.	Sept. 11
Oct. 1	St. Paul, Minn.	Aug. 23
Oct. 1	Virginia, Minn.	Aug. 23
Oct. 1	Wichita, Kan.	Sept. 11
Oct. 1	Fulton, Mo.	Sept. 11
Oct. 1	Mt. Pleasant, Ia.	Sept. 11
Oct. 3	Brevard, N. C.	Sept. 18
Oct. 10	Cherokee, Okla.	Sept. 18
Oct. 17	Ashley, N. D.	Sept. 18
Nov. 23	Winner, S. D.	Sept. 11

FEDERAL GOVERNMENT WORK

Sept. 22	Material — Charles Town, W. Va.	Aug. 21
Sept. 22	Post Office — Charleston, W. Va.	Aug. 21
Sept. 22	Storehouse — Watertown, Mass.	Sept. 11
Sept. 22	Rip Rap—Baltimore, Md.	Sept. 18
Sept. 23	Heating System—Tacoma Park, Washington, D. C.	Sept. 11
Sept. 24	Building — Spec. 4009 — Puget Sound, Wash.	Sept. 11
Sept. 24	Boat House—Reedy Island, Del. Adv. Sept. 11.	Sept. 11
Sept. 24	Laundry — Spec. 4006 — Annapolis, Md.	Sept. 11
Sept. 24	Mechanical Stokers—Spec. 4010—Charleston, S. C.	Aug. 28
Sept. 24	Reciprocating Air Compressor — Spec. 3837 — Puget Sound, Wash.	Aug. 28
Sept. 25	Dredging — New London, Conn.	Sept. 18
Sept. 26	Post Office and Custom House—Providence, R. I. Adv. Aug. 21.	Aug. 21
Sept. 29	Dredge, etc.—Wilmington, N. C. Adv. Aug. 28.	Aug. 28
Sept. 29	Dredging—Baltimore, Md. Adv. Sept. 11.	Sept. 11
Sept. 30	Remodeling Hospital—Boston, Mass.	Aug. 28
Sept. 30	Dock—Charleston, S. C.	Sept. 4
Sept. 30	Hospital — Spec. 3931 — Pearl Harbor, Hawaii	Sept. 4
Sept. 30	Rubble Mound Breakwater Cleveland, O.	Sept. 4
Sept. 30	Sprinkler System—Philadelphia, Pa. Adv. Sept. 18.	Sept. 18
Oct. 1	Valves, Gates, etc.—Denver, Colo. Adv. Aug. 21.	Aug. 21
Oct. 1	Electric Lighting and Power Systems—Spec. 3982—Mare Island, Cal.	Aug. 28
Oct. 1	Electric Lighting, Water Supply and Fire Protection System — Spec. 3977A — Charleston, S. C.	Sept. 18
Oct. 1	Dredging — Spec. 4031 — Hingham Mass.	Sept. 18
Oct. 2	Equipment—Denver, Colo.	Sept. 11
Oct. 3	Post Office—Midland, Mich.	Sept. 11
Oct. 3	Lock and Dam — Pittsburgh, Pa. Adv. Sept. 11.	Sept. 11
Oct. 4	Dredging — Wilmington, Del. Adv. Sept. 11.	Sept. 11
Oct. 6	Post Office—St. Johnsburg, Vt.	Aug. 28
Oct. 6	Levee Work — St. Louis, Mo. Adv. Sept. 11.	Sept. 11
Oct. 6	Dredging — New York, N. Y. Adv. Sept. 18.	Sept. 18
Oct. 6	Building—Marianna, Ark.	Sept. 11
Oct. 8	Dredging—Detroit, Mich. Adv. Sept. 11, 18.	Sept. 11
Oct. 10	Dredge—New York, N. Y. Adv. Aug. 28.	Aug. 28
Oct. 10	Post Office—Lock Haven, Pa.	Sept. 4
Oct. 14	Post Office—Pratt, Kan.	Sept. 11
Oct. 15	Derricks—Florence, Ala. Adv. Sept. 18.	Sept. 18
Oct. 15	Repairing Dyke—Philadelphia, Pa. Adv. Sept. 18.	Sept. 18
Oct. 15	Quarters and Mess Hall—Bismarck, N. D.	Sept. 18
Oct. 22	Power Plant Improvements —Spec. 3956—Pearl Harbor, Hawaii	Sept. 11
Nov. 3	Post Office and Court House —Honolulu, H. T.	Aug. 21

MISCELLANEOUS

Sept. 22	Wharf—Naramata, B. C.	Aug. 28
Sept. 22	Flood Gates—Pine Bluff, Ark.	Sept. 11
Sept. 23	Land and River Borings—New York, N. Y.	Sept. 11
Sept. 23	Turbines, etc.—Saskatoon, Sask. Adv. July 24.	July 24
Sept. 25	Garbage Incinerator — Monessen, Pa.	Sept. 18
Sept. 29	Lock, Dam, etc.—Bobcaygen, Ont.	Sept. 18
Oct. 2	Wharf — St. Laurent de Orlean, Que.	Sept. 18
Oct. 2	Wharf—Quebec	Sept. 18
Oct. 6	Pumping Equipment—Los Angeles, Cal.	Sept. 18

Where name of official is not given inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

Conn., Groton—Bilderbeck & Langdon, engrs., 253 State St., New London, receive bids about Oct. 1, extending water system for Boro. Work involves 12,000 ft. 12 in. and 1000 ft. 6 in c.i. pipe. About $50,000. E. R. Gorman, supt. Noted July 24.

Waterworks (Continued)

N. C., Greensboro—City plans to build addition to waterworks plant. About $50,000. W. B. Bandy, Greensboro, engr.

Fla., St. Augustine—See "Sewers."

Mich., Caro—Caro Water Co. plans to build pumping plant and rein.-con. storage reservoir. About $25,000. Private plans.

Mich., Marysville—Wills-Lee Co. plans to lay pipe line from here to Port Huron city limits to connect with Port Huron water mains, one line to connect at 24th and Moak Sts., Port Huron, and other at Military and Ravenswood Sts., Port Huron, to supply water for construction purposes at plant here. Work involves 25,000 ft. 10-12 in. c.i. pipe. W. H. Watkins, Marysville, engr.

Mich., Port Huron—City having plans prepared for rein.-con. intake well with gate valves to provide for pure water supply, while intake pipe is being repaired or cleaned. About $10,000. E. R. Whitmore, city engr.

Kan., Girard—City plans to improve waterworks system. About $44,000. W. B. Rollins & Co., 209 Ry. Exch. Bldg., Kansas City, Mo., engrs.

Neb., Lincoln—T. H. Berg, city clk., soon lets contract laying water mains and fire hydrants in Fire Dist. No. 2, involving 18,660 ft. 4 8-in. c.i. piping, 6300 cu.yd. earth excav. and 22 hydrants. About $30,000. G. W. Bates, city engr.

Mont., Musselshell—City plans to install complete waterworks system. About $28,000. R. Bushnell, Roundup, engr.

Mo., Kirksville—City plans to improve waterworks system. About $30,000. W. B. Rollins & Co., Ry Exch. Bldg., Kansas City, engrs.

Okla., Altus—City voted $45,000 bonds to extend waterworks. Johnson & Benham, Kansas City, Mo., engrs.

Okla., Enid—City soon lets contract building waterworks, involving 100,090 ft. 6-14 in. c.i. pipe, 40,560 lb. standard castings, 77 ft. 4-14 in. valves and valve boxes and six 6 in. fire hydrants. Black & Veatch, Interstate Bldg., Kansas City, Mo., engrs.

Okla., Minco—City voted $20,000 bonds to replace steam engine with oil engine, deepen wells and build extensions to watermains. Engineer not selected.

Cal., Brawley—City plans election to vote on $125,000 bonds to extend and improve waterworks system. G. R. Wade, city engr.

Cal., Fillmore—City Trustees plan election to vote on $20,000 bonds to build additional pumping plant and extend distributing system.

BIDS DESIRED.

Mich., Hamtramck—Until Sept. 25, by J. C. Schultheiss, village clk., furnishing materials and labor laying water mains and appurtenances in Yemens, Evaline, Christopher and McDougal Aves., involving 2805 ft. 6-8 in. pipe, 4 fire hydrants, gates, etc. G. Jerome, 1331 Majestic Bldg., Detroit, engr.

Mont., Judith Gap—Until Sept. 22, by Town Council, building 6 in. water mains in Impvt. Dist. No. 7. About $15,000. Gerharz-Jacqueth Co., 514 1st Natl. Bank Bldg., Great Falls, engrs. Noted Aug. 7.

Colo., Flagler—Until Sept. 29, by Town Council, building waterworks system, involving 16,950 ft. 4-10 in. c.i. pipe, 28 fire hydrants, 5 tons specials, twenty-two 4-10 in gate valves and boxes, etc. About $60,000. R. S. Salisbury, 1415 East Colfax Ave., engr.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★Mich., Detroit—City let contract to U. S. Cast Iron Water Pipe Co., 122 South Michigan Blvd., Chicago, for 1500 tons Class "B," 6 and 8 in. pipe at $55.50 per ton; Amer. Cast Iron Pipe Co., 512 1st Natl. Bank Bldg., Chicago, 1500 tons Class "B," 6 and 8 in. pipe, $0.96 per lin.ft. for 6 in. pipe in 18 ft. lengths and $1.36 per lin.ft. for 8 in. pipe in 18 ft. lengths; Flower Mfg. Co., Clayton and Parkinson Ave., five 30 in. gate valves at $1350 each, total, $6750.

★Mich., Ecorse—City let contract to T. C. Brooks & Son, West Grand Blvd., Detroit, furnishing and installing 8000 ft. water mains with hydrants, valves and 2 motor driven centrifugal pumps, 500 gal. capacity per minute, etc., $24,000; Pitt Constr. Co., Wyandotte, 500,000 gal. rein.-con. reservoir, $19,000; Pittsburgh-Des Moines Steel Co., 801 Curry Bldg., Pittsburgh, elevated steel tank with 150,000 gal. capacity. Noted Aug. 21.

★Kan., Lawrence—Haskell Institute let contract building 40,000 gal. steel tank and tower, to Pittsburg-Des Moines Steel Co., Des Moines, Ia., $7485.

★Mo., Marysville—City let contract building 2 reservoirs, rein.-con. coagulatory plant, rein.-con. storage plant, two 600 g. p. m. motor driven pumps, and one 7000 g. p. m. low service pump, to Randall Constr. Co., Kansas City, $35,500. Noted Aug. 21.

★Mo., Weston—City let contract extending pipe line and building well and concrete reservoir, to C. P. Breen, Parkville, $13,400. Noted Aug. 14.

★Okla., Altus—City let contract improving waterworks system, to Maney Brothers, 304 Empire Bldg., Oklahoma. About $62,500. Noted Aug. 28.

★Wash., Seattle—Bd. Pub. Wks. let contract laying 2636 ft. 8 in. and 256 ft. 12 in. c.i. water mains in 12th Ave. N. E., et al, to G. Alfonzo, 6th N. W. and West 88th Sts., $12,483. Noted Aug. 21.

Sewers

PROPOSED WORK

W. Va., Parkersburg—City plans to build 8-in. sanitary sewers in Oak St. from 15th to 19th Sts. and Beaver St. from alley south of 18th to 19th Sts., etc. Bonds for $300,000 voted for project. L. G. Merril, city engr.

N. C., Greensboro—City plans to build sewer extension. About $25,000. W. B. Bandy, Greensboro, engr.

Fla., Clearwater—City voted $15,000 bonds to build sanitary and storm sewers in various streets.

Fla., St. Augustine—City plans election soon to vote on $500,000 bonds to install sewerage system, extend water service, build auditorium and pave streets.

Mich., Mt. Clemens—J. H. Mathews, city clk., soon lets contract laying 24 in. vitr. crock rein.-con. sewer with 6 in. concrete shell on outside in Crocker Ave. About $25,000.

Ill., Nokomis—City soon lets contract building sanitary sewerage system to include 20,000 ft. 8-12 in. pipe. Imhoff tank and sludge bed, also 10,000 ft. 8-10 in. pipe, ejector and compressor station. About $43,000 and $25,000 respectively. J. J. Woltmann, city engr.

Mont., Billings—City election Sept. 30, to vote on $400,000 bonds to build storm sewers in various streets. E. M. Sneckenberger, city engr.

Wash., Spokane—City having preliminary plans prepared building 5.5 mi. laterals and sectional sewers in Sewer Dist. No. 13. About $100,000. A. D. Butler, city engr.

Okla., Garber—City Council soon lets contract building lateral sewers in various streets, involving 28,864 ft. 8-10-in. vitr. clay pipe, 500 cu.yd. excav., 120 cu.yd. concrete, 59 manholes and 187 flush tanks. Black & Veatch, Interstate Bldg., Kansas City, Mo., engrs.

Okla., Nowata—See "Streets and Roads."

Ont., Orillia—City having plans prepared by James, Loudon & Hertzberg, engrs., 36 Toronto St., Toronto, laying 3200 ft. 15-28-in. vitr. sewer in Neywash St. About $11,800.

BIDS DESIRED

N. J., Phillipsburg—Until Sept. 24, by town, building sewage disposal plant. C. E. Tilton, town engr.; advertised in this issue.

Pa., Baldwin—Until Oct. 1, by Bd. Comrs. Baldwin Twp., building 2 mi. sanitary sewers in drainage area No. 1, Fairhaven. T. J. McGovern, twp. engr.

Wis., Elkhorn—Until Sept. 24, by A. C. Olson, city engr., excavating and laying 9610 ft. 8 in. sewers, 1240 ft. 4 in. c.i. pipe, 19 manholes and 4 flush tanks in Main St. About $30,000.

Wis., Viroqua—Until Sept. 26, by E. J. Older, city clk., furnishing and laying 1362 ft. 10 in. and 1209 ft. 8 in. vitr. pipe sewers, 1863 ft. 6 in. sewer connections, 8 manholes, etc., also laying 1300 ft. 8 in., 48 ft. 6 in. and 1800 ft. 4 in. water pipe, etc.

Minn., Breckenridge—City receiving bids building sewers in various streets, involving 5728 ft. 8-36 in. sanitary sewers and 10,594 ft. 8-24 in. storm sewers, 42 manholes and 2 flush tanks. About $26,000. R. R. Waite, clk.

Neb., Scribner—Until Oct. 3, by City Clerk, laying 5 mi. 8-12 in. vitr. clay pipe sewers in various streets. About $42,000. J. A. Bruce, 204 Bee Bldg., Omaha, engr.

Mont., Billings—Until Oct. 7, by city, building 32,000 ft. 8 in. sanitary sewers in various streets. E. M. Sneckenberger, city engr.

Mont., Judith Gap—Until Sept. 22, by Town Council, building 1 mi. 6 in. pipe sewer and sewage disposal plant. About $20,000. Gerharz-Jacqueth Co., 514-1st Natl. Bank Bldg., Great Falls, engrs. Noted Aug. 7.

Ont., London—Until Sept. 22, by S. Baker, city clk., laying 11,300 ft. 8-15 in. vitr. sewers. About $30,000. H. A. Brazier, City Hall, engr. Noted Sept. 4.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★Mass., Dedham—Metropolitan Water & Sewer Bd., Boston, let contract laying 1559 ft. 33 x 36 ft. rein.-con. sewer pipe, Wellesley Extension, to J. C. Cavanagh, 25 Medway St., Dorchester, $47,675. Work involves 2500 cu. yd. earth and 400 cu. yd. rock trenching, 20 cu. yd. brick and 900 cu. yd. concrete.

★Mass., Longmeadow (Springfield P. O.)—City let contract laying 36,788 ft. 8-18 in. vitr. tile drain sewers and 12,773 sq. yd. macadam in various streets, to Vacovone & Tozzoli, 52 Market St., Hartford, Conn.

★Mass., Needham—Metropolitan Water & Sewer Bd., Boston, let contract laying 3849 ft. 27 x 30 ft. concrete and 33 x 36 ft. rein.-con. sewer, in Wellesley Extension, to Rendle Stoddard Co., Chelsea, $72,046. Work involves 4000 cu. yd. earth and 500 cu. yd. rock trenching and 2250 cu. yd. concrete.

★Mass., Stoneham (Boston P. O.)—Metropolitan Water & Sewer Bd., Boston, let contract laying 3650 ft. 15-20 in. vitr. sewer pipes, in Reading Extension, to Rendle Stoddard Co., Chelsea, $26,016. Work involves 3000 cu.yd. earth and 100 cu.yd. rock excav., 30 cu.yd. brick and 100 cu.yd. concrete.

★N. Y., New York—H. Bruckner, pres. Bronx Boro., let contract to Fenlack Constr. Co., building storm water drain and appurtenances in East 233rd St., cost $132,213, combined sewers and appurtenances in Eden Terrace, $122,534. Noted Sept. 4.

★N. J., Somerville—Town let contract building sewer in Main St., to A. H. Conyne, Somerville, $29,703.

★Pa., Pittsburgh—City let contract laying 100 ft. 9-in. vitr. and 750 ft. 12-in. rein.-con. sewer pipe in Fallowfield Ave., to F. and F. Diulus, 40 Boundary St., $2429; 941 ft. 15 in. rein.-con. sewer pipe in Grandview Ave., to Critelli, Ricca & Zapp, 218 13th St., Sharpsburg, $3982; 204 ft. 10-in. rein.-con. and 2130 ft. 8-in. vitr. sewer pipe in Richmond St. and 1400 ft. 15-in. rein.-con. sewer pipe in McCandless St., to Manella & Lucenti, 6610 Rowan Ave., $5326 and $5024 respectively. Noted Aug. 28.

★W. Va., South Charleston—City let contract installing complete sewerage system, to McNichols Co., 924 South Kilbourn Ave., Chicago, Ill. About $140,000. Noted May 8.

★Fla., Leesburg—City let contract installing 5 mi. sewers and 1 septic tank, to Owens & Harwell, Tampa, $38,771. Noted Aug. 28.

★O., Bexley—L. S. Higgins, clk., let contract laying 6000 ft. 36-60 in. main sewers with branches, running in northerly direction, and 3200 ft. 15 in. and 4800 ft. 18 in. sanitary sewers in same trench with main sewers, to Sheets Constr. Co., Columbus, $195,000. Noted Sept. 11.

★O., Lima—A. L. Metheany, dir. pub. serv., let contract building Collett St. Relief Sewer, Contr. No. 1, to J. W. Farley, 118 North LaSalle St., Chicago, $523,000. Noted Aug. 7.

★Mich., Detroit—City let contract furnishing labor and material (except manhole rings and covers) building 5372 ft. 2 ft. 9 in. x 4 ft. 3 in. brick sewer in Newport Ave. from Waterloo to Forest Aves., to J. A. Mercier, 216 Hammond Bldg., $75,208. Noted Sept. 11.

★Mich., Detroit—Dickinson Real Estate Exch., 205 Old Whitney Bldg., rejected bids building 12,226 ft. vitr. crock lateral sewerage system, Avon Park Subdivision. About $20,000. Work will be done by day labor. Noted Aug. 28.

★Mich., Royal Oak—Baker Land Co. let contract furnishing labor and material building lateral sewerage system, Bronx Subdivision, involving 15,000 ft. 8-12 vitr. sewer pipe, etc., to Thorp & King, Royal Oak. Noted Aug. 14.

★Minn., Walnut Grove—City let contract building 4465 ft. 80 in., 2977 ft. 8 in. and 1122 ft. 10 in. vitr. sewer tile, including 1 lampholes 62 manholes and disposal tank with septic tank, to O'Neil & Preston, 606 6th St., St. Paul, $41,275. Noted Aug. 28

Sewers (Continued)

★**Kan., Belle Plaine**—City let contract building sewage disposal plant and 6¾ mi. sewers in various streets, to E. M. Eby, Wellington, $38,033. Noted Sept. 4.

Kan., Stafford—City let contract building 5260 ft. rein.-con. storm sewers, to Amerman & Snyder, Salina, $23,403.

★**Neb., Newman Grove**—City let contract building sanitary sewer in various streets, involving 22,070 ft. 8-15 in. vitr. pipe, to A. A. Dobson, Lincoln. About $29,500. Noted July 3.

★**Neb., Osceola**—City let contract building sanitary sewers and disposal plant, involving 9800 ft. 8-12 in. vitr. pipe, and 27 x 60 ft. cameron tank, to H. J. Peterson & Co., Farnam Bldg., Omaha, $61,299.

★**Wyo., Lusk**—City let contract laying 6270 ft. 6 and 8 in. sewer pipes, to Cordon Constr. Co., 334 Century Bldg., Denver, Colo. About $17,000. Noted July 10.

★**Tex., Seguin**—Comrs. Guadalupe Co. let contract building rein.-con. drainage structures on Highway No. 3 from here to Gonzales Co. line, to J. W. Goodrum, Seguin, $16,240. Noted Sept. 11, under "Streets and Roads."

★**Cal., Willows**—City let contracts building sewers in Dist. No. 2 as follows: digging and laying pipe, to J. Heafey, 22 Mesa St., Oakland, $16,066; furnishing pipe, to H. C. Muddox, $9622; motor and pump, to California Hydraulic Eng. Co., 70 Fremont St., San Francisco, $914; furnishing cement, to D. C. Church, 798 10th St., San Francisco, $981. Noted July 31.

★**Ont., Walkerville**—Essex Border Utilities Comn., Windsor, let contract building brick and concrete sewage pumping station here, to R. Westcott & Co., 39 Ouellette Ave., Windsor. About $13,000.

Bridges

PROPOSED WORK

Pa., Daguscahonda—Bd. Supervs. Ridgway Twp., Elk Co., soon lets contract building iron bridge over Elk Creek on present stone abutments, 52 ft. span, rein.-con. flooring. B. H. Rhinesmith, Ridgway, Secy.

Ga., Chatsworth—Bd. Supervs. Murray Co. soon lets contract building 60 ft. span bridge, 10 ft. roadway, over Holly Creek, on Teasleys Pl., 80 ft. span, 10 ft. roadway, over Conasauga River, to be known as Alaculsey Bridge, 25 ft. span, 16 ft. roadway, on old federal road, three 20 ft. spans, 12 ft. roadway, 20 ft. span, 16 ft. roadway, over Pole Cat Creek 50 ft. span, 12 ft. roadway, over Mill Creek, 50 ft. span, 12 ft. roadway, over Holly Creek, near Hasslers Mill, 20 ft. span, 12 ft. roadway, over Pin Hook Creek, on Fashion Rd., 20 ft. span, 16 ft. roadway, over Pin Hook Creek, on Cleveland and Spring Place Rd., all rein.-con. Alternate bids will be received on steel frames, with concrete floors and concrete abutments to be built of same general dimensions as to length, width, height and length of wings and same carrying capacity. J. M. Campbell, chn.

Wis., Mukwonago—Wisconsin Highway Comn., Madison, having surveys made for Mill Race Bridge, here, rein.-con., two 30 ft. spans, baluster railings and concrete abutments.

Neb., Henry—V. B. Kirkham, clk. Scotts Bluff Co. (Gering), soon lets contract building 600 ft. rein.-con. bridge, 16 ft. wide, to have twelve 50 ft. arches. Work involves 1100 cu. yd. rein.-con., 10,000 lin. ft. wooden piling and 30,000 cu. yd. earth approach and fill. About $70,000. Noted Aug. 14.

Neb., Minatare—V. B. Kirkham, clk. Scotts Bluff Co. (Gering), soon lets contract building 600 ft. rein.-con. bridge, 16 ft. wide, to have twelve 50 ft. arches. Work involves 1100 cu. yd. rein.-con., 10,000 lin. ft. wooden piling and 30,000 cu. yd. earth approach and fill. Noted Aug. 14.

Neb., Morrill—V. B. Kirkham, clk. Scotts Bluff Co. (Gering), soon lets contract building 600 ft. rein.-con. bridge, 16 ft. wide, to have twelve 50 ft. arches. Work involves 1100 cu. yd. rein.-con., 10,000 lin. ft. wooden piling and 30,000 cu. yd. earth approach and fill. About $70,000. Noted Aug. 14.

Neb., Scotts Bluff—V. B. Kirkham, clk. Scotts Bluff Co. (Gering), soon lets contract building 600 ft. rein.-con. bridge, 24 ft. wide, to have twelve 50 ft. arches. Work involves 1820 cu. yd. rein.-con., 13,200 lin. ft. wooden piling, 41,289 cu. yd. earth approach and fill, 3332 cu. yd. clay and 1003 cu. yd. gravel surfacing. About $100,000. Noted Aug. 14.

Mo., Charleston—See "Streets and Roads."

Wash., Yakima—Comrs. Yakima Co. plan to raise and repair Piland Bridge, steel span, which recently collapsed in Sunnyside Canal. About $10,000. W. C. Marion, co. engr.

Oregon—State Highway Comn., Portland, soon lets contract building bridge on West Side Highway, Yamhill Co., involving 300 cu. yd. class A concrete in bridge, 60 cu. yd. class A concrete in culvert, 50,000 lb. reinforcing steel, 300 lin. ft. concrete handrail, 600 lin. ft. wooden piling, cost to exceed $10,000; 40 ft. bridge over Crow Creek, Lane Co., 118 cu. ft. concrete handrail and 160 lin. ft. wooden piling, $10,000. H. Nunn, Salem, state highway engr.

Oregon—State Highway Comn., Portland, soon lets contract building bridge over Sand Creek, Douglas Co., involving 35,000 lb. reinforcing steel, 223 cu. yd. Class "A" concrete and 226 lin. ft. concrete handrail. Cost to exceed $10,000. H. Nunn, state highway engr.

Ont., Pembroke—See "Streets and Roads."

BIDS DESIRED

Pennsylvania—Until Oct. 3, by State Highway Dept., Harrisburg, building 12 and 14 ft. span bridges in Boggs and Bethel Twps., Armstrong Co., 12 ft. span, Summerhill Twp., Crawford Co., 8 and 12 ft. spans, Oakland and Harmony Twps., Susquehanna Co., 10 ft. span, Chanberry Twp., Venango Co., 10 ft. span, Lemon Twp., Wyoming Co.; also superstructure for one 42 ft. clear span through rein.-con. girder bridge, Vanderbilt Boro., Fayette Co., and for fabrication and erection complete of superstructure for one through plate girder highway bridge, 52 ft. centre to centre bearings, 25 ft. 8 in. centre to centre web plates, Davidson Twp., Sullivan Co. L. S. Sadler, state highway comr.

Pa., Conshohocken—Until Sept. 22, by city, building rein.-con. and steel bridge over Schuylkill River. About $175,000. B. H. Davis, 17 Battery Pl., New York City, engr. Noted Dec. 19.

Pa., Ebensburg—See "Streets and Roads."

Pa., Ebensburg—Until Sept. 24, by Comrs. Cambria Co., building rein.-con. girder bridge over Elk Run on road leading from Morrellville to Southmont, Lower Yoder Twp., 35 ft. long, 30 ft. wide. About $25,000. Owen & Plummer, Otto Bldg., Johnstown, engrs.

Ga., Trenton—See "Streets and Roads."

Ala., Birmingham—Until Sept. 29, by Bd. Revenue Jefferson Co., building 100 ft. rein.-con. bridge on Birmingham and Warrior Rds., State Rd. No. 1. Work involves 326 cu. yd. class A and 151 cu. yd. class C concrete, 110 cu. yd. stone masonry, taken down and rebuilt, 48,500 lb. reinforcing steel, 940 cu. yd. earth and 20 cu. yd. solid excav. Alternate bids will be considered on 100 ft. arch span and 100 ft. girder bridge of several spans. W. S. Keller, c/o State Highway Dept., Montgomery, engr.

Wis., Kenosha—Until Sept. 26, by Street Assessment Com., City Hall, building rein.-con. and bascule bridge on Main St. over harbor, here, consisting of 4 arch approach spans from 40-46 ft., 2 girder spans, 30 and 19 ft., 230 lin. ft. approaches and Strauss trunnion bascule span, 167 ft. center to center of trunnions, also for dismantling and removing present substructure and remove present superstructure into a substructure to be furnished by city at Middle St. crossing of north branch of the harbor on Washington Island; advertised in this issue.

N. B., Fredericton—Until Sept. 24, by P. J. Veniot, minister dept. pub. wks., building bridge over Little River mouth, Hamfield Parish, Queens Co. About $25,000.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★**N. Y., Schenectady**—E. S. Walsh, supt. pub. wks., Capitol, Albany, let contract building abutments and approaches on Schenectady-Scotia bridge, rein.-con., extending from junction of State St. and Washington Ave. across Barge Canal Terminal channel, Van Slyck Island, Barge Canal main channel, Hog Island and the Scotia channel, to point about 300 ft. north of junction of Schonowee and Mohawk Aves., Scotia Village, to Walsh Constr. Co., Herald Bldg., Syracuse, $198,570. Noted Aug. 21.

★**N. Y., Watertown**—City let contract building rein.-con. and steel bridge over Black River on Court St., to Peckham Constr. Co., Niagara Life Bldg., Buffalo, $335,815. Noted July 17.

★**N. Y., Watertown**—Bd. Pub. Wks. let contract building 2 span rein.-con. and steel bridge, 200 ft. long, 39 ft. wide, over Black River on Factory St., to Walsh Constr. Co., Herald Bldg., Syracuse, $53,900. Noted Aug. 21.

Pa., Sunbury—Comrs. Northumberland Co. received lowest bid building rein.-con. girder bridge over Chillisquaque Creek in West Chillisquaque Twp., near here, from Whittaker & Diehl, Union Trust Bldg., Harrisburg. About $18,000. Noted Aug. 21.

★**Ala., Birmingham**—Bd. Revenue Jefferson Co. let contract building 100 ft. span rein.-con. bridge over Rock Creek, on Taylors Ferry Rd., to A. F. Bearden. About $19,000. Noted July 24.

★**Illinois**—State Highway Comn., Springfield, let contract building Keller Bridge, Johnson Twp., Christian Co., to A. Culberson. About $17,000.

★**Kan., Bonner Springs**—Comrs.-Wyandotte Co. (Kansas City), let contract building 100 ft. steel pony truss bridge, 22 ft. wide, concrete flooring and abutments, to A. J. Kopler, 700 West 12th St., Kansas City, $10,800. Noted Aug. 28.

★**Mont., Great Falls**—State Highway Comn., Helena, let contracts building 970 ft. concrete bridge, 42 ft. wide, on 1st Ave. and 1200 ft. concrete bridge, 44 ft. wide, on 10th St., both over Missouri River, to Porter Bros., Bway and Hardesty Rd., Seattle, Wash. About $242,000 and $232,000 respectively; 3% deduction on both bridges. Noted Aug. 7.

★**Washington**—State Highway Bd., Olympia, let contracts building 300 ft. steel bridge approaches over Quinault River, Grays Harbor Co., involving 200 cu. yd. concrete, 258,599 lbs. structural steel and 7400 lbs. reinforcing steel, to R. E. Meith, Portland, $44,181; 75 ft. rein.-con. arch bridge over Samish River, near Allen, Skagit Co., involving 580 cu. yd. concrete, 3700 lin. ft. wooden piling, 14,000 lb. steel reinforcing bars and 600 cu. yd. earth approach and fill for abutments and footings, to Norris Bros., Burlington, $15,980.

★**Wash., Olympia**—Comrs. Thurston Co. let contract building concrete bridge with wooden approaches, on West Side, to Union Bridge Co., Olympia, $132,000.

★**Wash., Underwood**—State Highway Comn., Olympia, let contract building 190 ft. steel bridge with approaches over White Salmon River, here, Skamania and Klickitat Counties, to Illinois Steel Bridge Co., Hutton Bldg., Spokane. Work involves 445 cu. yd. concrete, 4500 lbs. reinforcing bars and 1300 lin. ft. wood piling. Cost $35,960. Noted Aug. 14.

★**Ore., Astoria**—Port of Astoria Comn. let contract building 1100 ft. timber trestle and extending belt line railway to Astoria Paper Co. plant, to J. A. McEachern Co., foot of Kellogg St., Portland. About $18,000.

Cal., Hanford—Bd. Supervs. King Co. received bids building rein.-con. bridge over Kings River, south of Kingsburg, from Cotton & McCauley, 55 Jessie St., San Francisco, $31,512; Frederickson & Shannon, Cary Bldg., Fresno, $31,730; A. Johnson, Kingsburg, $33,621. Noted Aug. 7.

★**Cal., Modesto**—Bd. Supervs. Modesto Co. let contract building 1400 ft. concrete girder bridge over Merced River, having 31 spans with rein.-con. pile foundation, to E. Green, Modesto, $112,600.

★**Cal., Redwood City**—City let contract building 3 bridges over Redwood Creek, on Maple Ave., Bway. Ave. and on Webster St., to C. J. Lindgren, Burlingame, $26,547.

★**Cal., Woodland**—Conaway Ranch let contract building one 84 ft. and one 400 ft. timber bridge on ranch, to M. P. Holmes, Capitol Natl. Bank Bldg., Sacramento, $24,800.

Structural Steel

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

Pa., Phila.—See "Miscellaneous."

★ **Mich., Ypsilanti**—See "Miscellaneous."

Reinforced Concrete

PROPOSED WORK

Ga., Chatsworth—See "Bridges."

BIDS DESIRED

Pennsylvania—See "Bridges."

Pa., Conshohocken—See "Bridges."

Pa., Ebensburg—See "Bridges."

Ala., Birmingham—See "Bridges."

Ont., Bobcaygeon—See "Miscellaneous."

PRICES AND CONTRACTS AWARDED

(★Indiactes award of contract)

★**Ala., Birmingham**—See "Bridges."

★**Ont., Port Arthur**—See "Industrial Works."

Streets and Roads

PROPOSED WORK

R. I., Woonsocket—City appropriated $16,800 to pave and curb North Main St. from Winter St. to city line; $49,400 to pave Social St. from George St. to city line; $67,000 to pave Cumberland St. from Cass Ave. to Cumberland Hill Rd.; also $49,000 to pave with granite blocks South St. from South Main St. to top of hill and from top of hill to Center St. with macadam.

New Jersey—State Highway Comn., Broad St. Bank Bldg., Trenton, rejected bids received Sept. 10, repairing State Highway Route No. 1, from Trenton to New Brunswick and Elizabeth and State Highway Route No. 4, from Rahway to Betsey Ross Farm, near Middleton, 18 ft. wide. A. L. Clover, ch. clk. Noted Aug. 28.

W. Va., Elkins—Randolph Co. plans to pave and build 50 ft. bridge and drainage structures on 5.75 mi. Staunton-Parkersburg Pike Rd., 16 ft. wide, involving 17,000 cu.yd. excav. and 53,955 sq.yd. 9 in. bituminous macadam (using local stone). About $103,700. F. A. Parsons, Elkins, engr.

W. Va., Grantsville—Calhoun Co. having plans prepared grading and draining 4.5 mi. Arnoldsburg-Spencer Pike Rd., 24 ft. wide, involving 27,500 cu.yd. excav. and 500 cu.yd. concrete. About $39,050. E. Starcher, Grantsvill, engr. Noted Sept. 11.

W. Va., Moundsville—Marshall Co. plans to pave and drain .48 mi. Narrow Rd., 16 ft. wide, involving 2000 cu.yd. excav., 3535 sq.yd. brick and 850 cu.yd. concrete base. About $32,700. R. C. Yoho, Moundsville, engr.

W. Va., St. Mary—City soon lets contract paving Clay St., involving 3960 sq.ft. 1 course concrete, 25,000 sq.ft. brick, 800 lin.ft. concrete curb and one 6 x 8 ft. culvert containing 60 yd. concrete. L. V. Carpenter, highway engr.

W. Va., Wellsburg—Brooke Co. plans to pave and drain 1 mi. River Rd., involving 6000 cu.yd. excav., 6200 sq.yd. concrete and 3188 sq.yd. bituminous macadam. About $28,800. G. W. Stenrod, Wellsburg, engr.

North Carolina—State Highway Comn., Raleigh, rejected bids received Aug. 28, hard surfacing 8 mi. roads, Graham Twp., Alamance Co. About $200,000. W. S. Fallis, c/o State Highway Dept., Raleigh, engr. Noted Aug. 21.

N. C., Burgaw—Pender Co. soon lets contract building 25 mi. gravel roads, Caswell Twp. Cost between $75,000 and $100,000. W. K. Allen, Odd Fellows' Bldg., Wilmington, engr.

N. C., Burgaw—Comrs. Pender Co. plan to build gravel roads. About $400,000. W. S. Fallis, care of State Highway Dept., Raleigh, engr.

N. C., Burnsville—Comrs. Yancey Co. plan to surface 27 mi. Marion-Micaville Rd. About $10,000. Engr. not selected.

N. C., Elizabethtown—Comrs. Bladen Co. plan to gravel roads. About $500,000. Address S. P. McNair, Tar Heel, chn. co. highway comn.

Fla., Clearwater—City voted $30,000 bonds as its share toward paving various streets. Total cost, $90,000.

Fla., Daytona—City voted $450,000 bonds to pave various streets.

Fla., Ft. Pierce—Comrs. St. Lucie Co. voted $20,000 bonds to build road from here to White City and $34,000 bonds for Okeechobee Rd. to Ten Mile Creek.

Fla., St. Augustine—See "Sewers."

Louisiana—State Highway Dept., New Orleans, soon lets contract gravel surfacing and draining 19.8 mi. Alexandria-Oberlin Highway, and 14.5 mi. Alexandria-Melville Highway, Rapides Parish. Former bids rejected. Noted Sept. 4.

La., Arcadia—Bienville Parish voted $1,000,000 bonds to build roads.

O., Bellaire—City election Nov. 4, to vote on $150,000 bonds to pave various streets, vitr. brick. H. Althar, city engr.

O., Columbus—City Council plans to grade, drain, curb, lay water mains and pave Ebner St., from Whittier to Siebert Sts., West Broad St. from Hague Ave. to west corporation line, and 11th Ave. from Cleveland to St. Clair Aves., also alley west of 17th St. from Bryden Rd. to Main St., alley west of Kellogg Ave. from Grove St. to second alley north, second alley north of Grove St. from Cleveland to Kellogg Aves., and alley north of Grove St. from alley west of and to Kellogg Ave., asphalt or brick. H. A. Maetzel, city engr.

O., Springfield—City plans to grade 1800 ft. Garfield Ave., 1st, 2nd, 3rd and 4th Sts., 30 ft. wide, involving 40,000 cu.yd. grading. About $21,000. W. E. Lucas, city engr.

Michigan—State Highway Comn., Lansing, soon lets contract grading, shaping, draining and surfacing 2 mi. State Trunk Line Rd. No. 24-8, Sects. A and B and 9.996 mi. No. 14-4, both 16 ft. wide, gravel, Isabella Co.; 1.716 mi. No. 10-9, Sect. B, 16 ft. wide, gravel, Alpena Co.; 0.994 mi. No. 33-1 and 1.006 mi. No. 32-2, 16 ft. wide, gravel, Oscoda Co.; 1.764 mi. No. 47-6, 16 ft. wide, gravel, Saginaw Co.; 2.343 mi. No. 13-1 and 3.072 mi. No. 17-3, 16 ft. wide, concrete, Kalamazoo Co.; 2.538 mi. No. 46-1, 16 ft. wide, gravel, Montcalm Co.; 3.759 mi. (shaping and draining only), No. 17-2, Sect. B, Jackson Co.; 0.979 mi. No. 11-15, 16 ft. wide, gravel, Grand Traverse Co.; 7.45 mi. No. 22-2, 16 ft. wide, gravel, Leelenau Co.; 2.536 mi. No. 16-1, 16 ft. wide, gravel, Lake Co., 1.254 mi. No. 49-1, 16 ft. wide, gravel, Ingham Co.; 3.407 mi. (shaping and draining only) No. 13-11, Sect. B. Charlevoix Co.; 5.035 mi. Assessment Dist. Rd. No. 168, 12 ft. wide, Class "B" gravel, Midland Co.; 6.631 mi. No. 237, 12 ft. wide, Class "C" stone bottom, gravel top, Kalamazoo and St. Joseph Counties; 4.465 mi. road, 16 ft. wide, gravel, Sanilac Co. F. F. Rogers, comr.

Michigan—State Highway Comn., Lansing, soon lets contract shaping, grading and surfacing 5.848 mi. State Trunk Line Rd. No. 43-3, 16 ft. wide, involving 54,889 sq.yd. waterbound macadam; 5.025 mi. State Trunk Line Rd. No. 67-1, 16 ft. wide, 47,168 sq.yd. waterbound macadam and 13,468 cu.yd. earth excav., both Alger Co. F. F. Rogers, com.

Mich., Detroit—City soon receives bids grading, paving with asphaltic concrete on 6 in. concrete base and curbing with Medina stone, 1800 ft. Garland Ave. from Shoemaker to Harper Aves., 26 ft. wide, cost $26,750; 2300 ft. Marquette Dr. from Marquette Park to Jefferson Ave., 24 ft. wide, $30,720. C. W. Hubbell, city engr.

Ill., Chicago—Sanitary Dist. soon lets contract paving 8 mi. highway along North Shore Channel of district from Lawrence Ave., here to Sheridan Rd., Wilmette, 30 ft. wide, involving 170,000 sq.yd. 1 course concrete pavement, 2200 cu.yd. class A concrete, 160,000 cu.yd. excav. and filling, 20,000 ft. concrete curbing, 170,000 sq.yd. wire mesh reinforcing, 300 ton steel bar reinforcement, 32,000 sq.yd. broken stone shoulders, 12,800 ft. 12-18 in. vitr. pipe drains, 7 stone chimneys, 1800 ft. 12 in. clay tile drains, 27,500 ft. guard fence and 73 catchbasins. G. L. Wisner, ch. engr.

Wis., De Pere—City having plans prepared for 32,000 sq.yd. pavement and 20,000 lin.ft. curb and gutter. H. R. Albert, city engr.

Wis., Kiel—City plans to grade and pave 2.1 mi. Fremont St., between 1st St. and city limits, 18 ft. wide, involving 12,000 sq.yd. asphalt or concrete pavement and concrete curb and gutter. About $25,000. F. Muth, city engr.

Minn., East Grand Fork—City plans to build asphalt or concrete roads in Dist. No. 1. About $250,000. A. Briggs, clk.

Kan., Bonner Springs—City soon lets contract repairing 6700 sq.yd. and oiling 41,000 sq.yd. macadam pavement, constructing 1700 sq.yd. concrete pavement, 600 cu.yd. grading and 1400 cu.yd. curbing. Shockley Eng. Co., 740 Reserve Bank Bldg., Kansas City, Mo., engrs.

Kan., Kansas City—Comrs. Wyandotte Co. rejected bids received Aug. 30, grading, paving and building culverts 1¼ mi. road, 16 ft. wide, concrete. O. K. Williamson, Kansas City, engr. Noted Aug. 28.

Kan., Winfield—City plans to pave 18 blocks Bway, Ann and East 6th Sts., asphaltic concrete, concrete curbing and guttering. Engr. not selected.

N. D., Minot—City plans to pave 3 mi. various streets, 30 ft. wide. About $20,000. E. J. Thomas, city engr.

Mont., Deer Lodge—Powell Co. voted $100,000 bonds to build roads. L. Williams, Deer Lodge, engr. Noted Jan. 26.

Mont., Great Falls—Cascade Co. voted $500,000 bonds to build Park-Park Highway and other roads. Noted June 26.

Mont., Hamilton—Ravalli Co. voted $100,000 bonds to build roads. L. Pertli, Hamilton, engr. Noted June 26.

Mont., Virginia City—Madison Co. voted $150,000 bonds to build roads. C. O. Adams, Virginia City, engr. Noted July 10.

Mo., Charleston—Mississippi Co. receives bids about Oct. 1, grading, draining, paving and building culverts on 15.3 mi. road from Charleston to Birds Point, 16 ft. wide, earth shoulders, involving 142,666 cu.yd. 1 course concrete on concrete base, 8 in. center and 6 in. sides. Plans also include one 70 ft. and one 60 ft. steel span bridges, concrete abutments, etc. About $475,000. Noted June 12.

Mo., St. Louis—See "Industrial Works."

Mo., St. Louis—Bd. Pub. Serv. soon receives bids resurfacing 2000 ft. Compton Ave. from Park to Choteau Aves., 35 ft. wide, involving 7333 sq. yd. vitr. brick; also 5250 ft. Page Blvd. from Vandeventer to Taylor Aves., 40 ft. wide, 22,150 sq. yd. asphalt, cost $62,150. C. M. Talbert, engr.

Tex., Ft. Worth—Tarrant Co. plans to grade, pave and build culverts on 5.8 mi. Ft. Worth and Dallas Rds., 20 ft. wide, concrete. About $245,982.

Tex., Lufkin—City plans to issue $75,000 bonds to improve various streets.

Oklahoma—State Highway Dept., Oklahoma, soon lets contract building 15 mi. road from Bortlesville south, 18 ft. wide, Federal Aid Project No. 15.

Okla., Ada—City having plans prepared by Johnson & Benham, engrs., Firestone Bldg., Kansas City, Mo., paving and guttering 65 blocks Main St. About $350,000.

Okla., Collinsville—City having plans prepared by Johnson & Benham, engrs., Firestone Bldg., Kansas City, Mo., paving 25 blocks, 25 ft. wide, brick or concrete. About $125,000.

Okla., Nowata—City soon lets contract paving various streets involving 63,000 sq. yd. brick, 41,580 cu.yd. excav., 41,950 combined curbing and guttering, 2380 ft. curbing, 840 ft. double guttering, 5000 ft. 10-24 in. storm sewers, 17 manholes and 51 catch basins. Archer & Stevens, New England Bldg., Kansas City, Mo., engrs.

Colo., Denver—City soon lets contract paving 7 blocks Acoma Dist. No. 1, asphaltic concrete, cost $43,431; 9760 sq.yd. concrete paving, Alley Paving Dist. No. 51, $20,831; 11,770 sq.yd. Alley Paving Dist. No. 50, $23,720. J. B. Hunter, city engr. Noted July 10.

Idaho, Lewiston—City plans to grade and pave new district, in eastern part of city. About $52,000.

Ariz., Mesa—City soon receives bids building 10 mi. cement walks. About $25,000.

Wash., Everett—City Comrs. rejected bids paving Baker Ave. from 23rd to 24th Sts., concrete, cost $11,205; also grading and building cement sidewalks on Virginia Ave. from Hewitt Ave. to 25th St., $13,506. Noted Sept. 11.

Wash., Port Orchard—City having estimates, plans and specifications prepared paving Bay St. from Harrison to Port Sts. Cost to exceed $10,000. W. A. McLeod, clk.

Wash., Tacoma—Comrs. Pierce Co. plan to pave 2 mi. Kapowsin Highway No. 23, concrete. About $40,000. E. A. White, co. engr.

Wash., Washtucna—City plans to build 21,864 sq.ft. concrete sidewalks and 2840 lin.ft. concrete curbs in Local Impvt. Dist. No. 1. Cost to exceed $10,000. A. J. Johnson, clk.

Wash., Yakima—Naches, Nob Hill, Cowiche and Tieton Rd. Dists. having preliminary plans prepared paving 7 mi. Harwood-Summitview Rd., concrete, also graveling 13 mi. roads leading from Harwood to Cowiche, Tieton and Naches Dists. About $140,000. W. C. Marion, co. engr. Noted Aug. 21.

Oregon—State Highway Comn., Salem, plans to grade and gravel 14 mi. road between Remote and Camas Valley, Coos Co. About $75,000. H. Nunn, state highway engr.

Ore., Forest City—City Council passed ordinance to drain, curb and pave Main St.; also 4th Ave. from 3rd to A Sts. Cost to exceed $10,000. W. P. Dyke, city recdr.

Cal., Marysville—G. W. Richards, city clk., receives bids about Nov. 1, improving 5th, 6th and D Sts. Work includes grading, 3 in. bituminous macadam pavement with 2 in. bitulithic surface, concrete curbs and gutters, 2 catchbasins, etc.

Cal., San Diego—City Council receives bids in November improving Granada St., involving 143,312 sq.ft. 5 in. concrete paving with oil and screenings top, 14,550 sq.ft. cement sidewalks, 2816 lin.ft. cement curb, etc. F. Rhodes, city engr.

Streets and Roads (Continued)

Ont., Pembroke—City plans to pave Sussex St. from McKay to Commercial Sts., McAllister St. from McKay to Commercial Sts., Pembroke St. from Commercial to Arnold Sts., and from K Hunts St. to Moffat's Crossing, Isabella St. from Maiden Lane to Doran St., 24 ft. wide, widening Lake St. and building concrete bridge over Muskrat River. Work involves 28,000 sq. yd. asphalt on concrete base and 16,000 lin.ft. concrete curbing. About $150,000. W. J. Moore, Pembroke, engr.

Ont., York—Town having plans prepared by F. Barber, engr., 40 Jarvis St., Toronto, for 15,850 ft. concrete sidewalks, 4 to 5 ft. wide. About $35,000.

Sask., Langham — Municipal Council passed by-law to expend $20,000 to improve roads and granolithic sidewalks.

Sask., Moosomin—Municipal Council soon receives bids building granolithic sidewalks; $28,000 has been appropriated for project. G. Polse, clk.

BIDS DESIRED

Massachusetts—Until Sept. 23, by State Highway Comn., Boston, building 5300 ft. road, 18 ft. wide, Wareham Twp., involving 10,000 sq.yd. asphalt macadam. A. W. Dean, state highway engr.

N. Y., Brooklyn—Until Sept. 24, by E. Riegelmann, boro. pres., regulating and repaving with permanent asphalt on 6 in. concrete foundation, roadway of High St. from Washington to Jay Sts., 4th Ave. from Bay Ridge to 5th Aves., with permanent Grade 1 old granite blocks on concrete foundation, Liberty St. from High to Fulton Sts.

N. Y., New York—Until Sept. 22, by F. L. Dowling, pres. Manhattan Boro., repairing asphalt pavements in railroad area, when and where directed by chief engineer, Bureau of Eng.

N. Y., S. I., St. George—Until Sept. 25, by C. D. Van Name, pres. Richmond Boro., regulating and repaving with bituminous concrete pavement and vitr. brick gutters on concrete foundation, roadway of North Burgher Ave. from Castleton Ave. to point 450 ft. south, with bituminous concrete pavement on concrete foundation, Sharpe Ave. from Richmond Terrace to Staten Island Rapid Transit R.R.

Pa., Ebensburg—Until Sept. 24, by Supervs. Summerhill Twp., c/o Comrs. Cambria Co., rebuilding 1.37 mi. road from Beaverdale to Wilmore, Summerhill Twp., also building concrete bridge over Laurel Run. About $100,000. Owen & Plummer, Otto Bldg., Johnstown, engr. Noted Aug. 21.

W. Va., Fayetteville—Until Oct. 6, by R. J. Stegall, clk. Fayette Co., paving 7 mi. highway, known as Beckman-Kanawha Falls Rd., 9 ft. wide, and building two 60 ft., one 24 ft. and one 18 ft. span bridges. Alternate bids will be received on asphaltic concrete, cement concrete, penetration macadam and other improved types of paving; advertised in this issue.

North Carolina—Until Sept. 28, by State Highway Comn., care of Division office, Greensboro, grading and gravel surfacing 8.2 mi. road, Person Co., cost $30,000; hard surfacing 4.6 mi. road, Guilford Co., $50,000. W. B. Fallis, Raleigh, state highway engr.

N. C., Concord—Until Sept. 25, by city, paving McGill, Church, Crowell, Marsh and Franklin Sts., involving 19,000 sq. yd. concrete. About $50,000. R. J. Long, city engr.

Ga., Trenton—Until Oct. 2, by Comrs. Roads and Revenues, Dade Co., building 9.8 mi. Federal Aid road, located 3 mi. south of here and Alabama state line known as Chattanooga-Birmingham Highway, involving 12 acres clearing and grubbing, 44,000 cu.yd. excav., 1050 cu.yd. concrete in headwalls, bridges, etc., 18,300 lb. steel reinforcing, in bridges, etc., 1400 lin.ft. vitr. clay pipe culverts, 25,500 cu.yd. sand clay surfacing; 2.4 mi. Federal aid road ½ mi. south of Wildwood and Tennessee state line, on Chattanooga-Birmingham Highway, involving 1 acre clearing and grubbing, 26,000 cu.yd. common and 6000 cu.yd. rock excav., 120 cu.yd. concrete in headwalls, bridges, etc., 1050 lb. steel reinforcing in bridges, etc., 6250 cu.yd. sand clay surfacing and 450 lin.ft. vitr. clay pipe culverts. I. H. Wheeler, chn. Noted Sept. 4.

Ala., Montgomery—Until Sept. 30, by G. W. Barnett, city treas., paving 9150 sq.yd. High St. from Hull to Jackson Sts., brick, asphalt, bitulithic, mineral rubber, wood block, concrete, vibrolithic concrete or asphaltic concrete; advertised in this issue.

Louisiana—Until Sept. 25, by State Highway Dept., Maison Blanche Annex, New Orleans, ditching and surfacing 11.3 mi. Melville-Palmetto Highway, St. Landry Parish, 20 ft. wide, gravel. D. Buie, state highway engr.

Mich., Mt. Clemens—Until Sept. 25, by J. H. Mathews, city clk., grading, curbing and paving Grand Ave. and Leander St. from Washington St. to Cass Ave., brick, asphalt or concrete. About $40,000.

Ill., Chicago—Until Sept 22, by Bd. Local Impvts. paving Ave. G from East 106th to East 108th Sts., involving 2580 ft. concrete curbing, 5000 cu.yd. filling, 4870 sq.yd. paving with 8 in. blast furnace slag or limestone on 2½ in. granite or traprock, 9 catchbasins, cost $21,000.

South Park Ave. from East 77th to East 91st., 19,540 ft. concrete curbing, 21,000 cu.yd. excav., 41,400 sq.yd. paving with 8 in. blast furnace or slag or limestone on 2½ in. granite or traprock, 21 catchbasins, $137,500.

North California Ave. from Devon to Albion Aves., 2470 ft. concrete curbing, 2800 cu.yd. grading, 5800 sq.yd. paving with asphalt on 6 in. concrete, 8 catchbasins, $24,000.

Higgins Ave from Edmunds St. to Austin Ave., 6340 ft. concrete curbing, 9000 cu.yd. grading, 11,600 sq.yd. paving with asphalt on 6 in. concrete, 13 catchbasins, $56,000.

East 106th St. from Ave. H to Indianapolis Ave., 4710 ft. sandstone curbing, 15,500 cu.yd. filling, 7540 sq.yd. paving with 8 in. blast furnace slag or limestone on 2½ in. granite or traprock, 16 catchbasins, $30,000.

West 37th Pl. from Kedzie Ave. to point 299 ft. west, 640 ft. concrete curbing, 450 cu.yd. grading, 980 sq.yd. asphalt paving on 6 in. concrete, $4500.

Altgelt St. from Long to Central Aves., Lotus Ave from Fullerton to Wrightwood Aves., Linder Ave. from Fullerton to Wrightwood Aves., Luna Ave. from Fullerton to Wrightwood Aves., 10,550 ft. concrete curbing, 5000 cu.yd. grading, 14,450 sq.yd. paving with asphalt on 6 in. concrete, 12 catchbasins, $58,500.

Alley between East 63d and East 64th Sts., Langley and Champlain Aves., 410 cu. yd. grading, 1260 sq.yd paving with 7 in. concrete, $4300.

Alley between West 65th Pl., West 66th St., Stewart and Normal Aves., 196 cu.yd. grading, 1220 sq.yd. paving with 7 in. concrete surfaced with asphalt, $3900. C. D. Hill, ch. engr.

Minn., Brainerd—Until Oct. 11, by Comrs. Crow Wing Co., improving 3.5 mi. State Rd. No. 6, 24 ft. wide, involving 20 acres clearing and grubbing, 43,600 cu. yd. grading, 20,000 cu. yd. overhaul, etc. About $19,000. C. L. Motl, Brainerd, engr.

Minn., Duluth—Until Sept. 25, by J. A. Farrell, city comr., paving 2500 ft. 22nd Ave. W., from Superior to 7th Sts., 20-34 ft. wide, involving 3700 sq.yd. vitr. brick, 4190 sq.yd. concrete, 400 cu.yd. earth and 820 cu.yd. rock excav. About $50,000. E. K. Cae, city engr.

Minn., Montevideo—Until Oct. 7, by Comrs. Chippewa Co., improving 5 mi. Federal Aid Project No. 88, State Rd. No. 1, 24 ft. wide, involving 40,931 cu. yd. grading, 89,783 cu. yd. overhaul, 6000 cu. yd. graveling, etc. About $30,000. F. P. Nelson, Montevideo, engr.

Kan., Ft. Scott—Until Oct. 6, by Comrs. Bourbon Co., macadamizing 43,207 ft. Jefferson Highway, 16 ft. wide. About 125,000. B. Boyle, engr.

Kan., Iola—Until Sept. 29, by Comrs. Allen Co., building 17,110 ft. Sect. A and B, Project No. 21, macadam base with gravel top, also one 27 ft. span arch bridge, 20 ft. roadway, involving 17 cu.yd. concrete and 130 lin.ft. piling. About $125,000.

Kan., Lawrence—Until Sept. 27, by Comrs. Douglas Co., paving with concrete 39,307 ft. Sects. E and F, Federal Aid Project No. 7, 18 ft. wide, also building bridges and walls. L. Dufee, engr.

Neb., Lincoln—Until Sept. 29, by W. L. Minor, clk., Lancaster Co., paving 5½ mi. Park Blvd., Asylum-Penitentiary Rd. and 14th St., involving 48,300 sq.yd. vertical fibre, 18,600 sq.yd. asphaltic concrete or 66,900 sq.yd. concrete on 5 in. concrete base, 55,300 lin.ft. concrete curbing, 520 lin.ft. guttering and curbing, 20,000 cu.yd. earth excav., 270 ft. 18 in. and 850 ft. 24 in. pipe, etc. About $290,000. A. H. Edgren co. engr.

Neb., Ralston—Until Sept. 23, by city clk., paving Burlington and 75th Sts., 20 ft. wide. Work involves 4700 yd. 6 in. concrete, 4200 lin.ft. curbing, 1000 yd. excav. and park guttering. About $17,500. H. A. Nelson Eng. Co., 424 Bee Bldg., Omaha, engrs. Noted Aug. 28.

Mo., Ridgeway—Until Oct. 6, by city, improving various streets, involving 24,700 sq.yd. concrete paving and 2500 cu.yd. concrete curbing and guttering. C. A. Stone, Ridgeway, engr.

California—Until Sept. 22, by State Highway Comn., 515 Forum Bldg., Sacramento, paving 4.7 mi. road between Houston School and northerly boundary, San Joaquin Co., involving 20,000 cu.yd. excav., 4065 cu.yd. Class "A" Portland cement concrete pavement, 150 cu.yd. Class "A" Portland cement concrete for culverts and monuments, etc.; 8.6 mi. road between 2 mi. north Acton and Palmdale, Los Angeles Co., 44,700 cu.yd. excav., 11,700 cu.yd. Class "A" Portland cement concrete pavement, 260 cu.yd. Class "A" Portland cement concrete for culverts and monuments, etc., 1.3 mi. road between Russel Ranch and former easterly boundary, 1600 cu.yd. Portland cement concrete pavement; 5.2 mi. road between southerly boundary and Conejo Grade, 1500 cu.yd. excav. and 7000 cu.yd. Portland cement concrete, Ventura Co. A. B. Fletcher, state highway engr.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

Maine—State Highway Comn., Augusta received only bid paving .21 mi. bituminous macadam road, Brunswick Twp., from Small & Ingalls, Bar Harbor, $9246. Noted Aug. 21.

★**Maine**—State Highway Comn., Augusta, let contract to A. D. Bridges Sons, Inc., Hazardville, grading, draining and surfacing 9.35 mi. Riverside Drive, 16 ft. wide, Vassalboro Twp., involving 80,890 sq.yd. bituminous macadam, 23,593 cu.yd. earth and 570 cu.yd. rock excav., $253,273. Noted Aug. 12.

★**Massachusetts**—State Highway Comn., Boston, let contract building 9900 ft. road, 22 ft. wide, Norwell Twp., to W. F. Loud & Sons, Quincy, $21,093. Work involves 8250 gal. bituminous macadam surfacing, 3750 ton broken stone and 9900 cu.yd. earth excav. Noted Sept. 4.

★**Mass., Boston**—City let contract paving Conant, Parker Sts., et al, 40 ft. wide, involving 3600 sq.yd. asphalt on scarified macadam surface, to Bermudez Co., 246 1st St., $24,445; Harvard St. (Dorchester), 40 ft. wide, 2490 sq.yd. asphalt on 4 in. concrete base and 1280 cu.yd. earth excav., to Rowe Constr. Co., Brighton, $19,683.

New York—State Highway Comn., Capitol, Albany, received bids Sept. 9, improving roads in following counties: (a) Chautauqua Co., 4.29 mi. Fredonia-Silver Creek, Part 2, Rd. No. 8003; completing roads in following counties:

(b) Chautauqua Co., 4.94 mi. Silver Creek-Forestville, Rd. No. 1469,

(c1) Columbia Co., 7.14 mi. Hollowville-Craryville, Rd. No. 763, (c2) 7.77 mi. Claverack-Chatham, Part 2, Rd. No. 1332;

(d) Chenango and Madison Counties, 6.18 mi. Earlville-Hamilton, Rd. No. 5585,

(e1) Delaware Co., 5.84 mi. Colchester Delancey, Rd. No. 1272, (e2) 3.39 mi. Franklin-Unadilla, Part 1, Rd. No. 1440, (e3) 4.31 mi. Delancey-Delhi, Rd. No. 1441-A.

(f1) Erie Co., 9.14 mi. Collins Center-Springfield, Rd. No. 1333, (f2) 3.18 mi. Transit, part 4, Rd. No. 1334—A-1, (f3) 0.59 mi. Transit, Part 4, Rd. No. 1334—B-1,

(f4) 1.06 mi. Marilla-Marilla Sta., Rd. No. 1491-A, (f5) 3.02 mi. Transit-Wolcottsburg, Rd. No. 1493,

(g1) Fulton Co., 5.13 mi. Ephratahn-Kecks Center, Part 2, Rd. No. 620, (g2) 2.9 mi. St. Johnsville-Oppenhemin, Part 2, Rd. No. 621,

(h) Hamilton Co., 1.97 mi. Eagle Bay-Sixth Lake, Rd. No. 1098-A,

(i) Madison Co., 4.89 mi. DeRuyter-New Woodstock, Rd. No. 5586-A,

(j) Ontario Co., 8.63 mi. Canandaigua-Orleans, Rd. No. 1278,

(k) Orange Co., 1.17 mi. Cornwall-West Point, Part 3, Rd. No. 5573,

(l) Otsego Co., 12.66 mi. Morris-Oneonta, Rd. No. 1302,

(m) Tioga Co., 5.5 mi. Richford-Hartford Mills, Rd. No. 1452,

(n1) Tompkins Co., 3.38 mi. Brooktondale-Speedsville, Part 1 and Slatersville Springs-Caroline, Parts 3 and 4, Rd. No. 1431, (n2) 5.86 mi. Cortland-Croton, Parts 3 and 4, Rd. No. 1433, from

Constantine Constr. Co., 240 Dewey Ave., Buffalo, (a) $130,517, (f2) $106,253, (f3) $30,043;

E. J. Bailey, Brockton, (a) $132,326;

Felton Constr. Co., 1450 Michigan Ave., Buffalo, (a) $132,613, (b) $107,902;

Town Bd., Hanover, (b) $109,450;

A. Colarusso, Hudson, (c1) $74,698, (c2) $127,158;

Streets and Roads (Continued)

S. Beskin, Beacon, (c1) $76,803;
Belmar Contg. Co., Inc., Troy, (c1) $78,-661;
J. Walker, 19 Steuben St., Albany, (c2) $124,299;
H. W. Roberts & Co., 610 Lansing St., Utica, (d) $88,579, (g1) $134,186, (i) $119,080;
Paddelford & King, Sherburne, (d) $88,-658;
Lane Constr. Co., 37 Colony St., Meriden, Conn., (e2) $80,778;
Universal Steel Export Co., Inc., 26 Cortlandt St., New York City, (e3) $203,-499;
Rosoff Eng. Co., 15 Park Row, New York City, (e3) $210,149, (h) $52,636,
R. Hopkins, Troy, (e3) $213,777, (h) $53,467, (l) $228,988;
H. C. Schroeder, Mercantile Bldg., Rochester, (f1) $217,503, (f2) $112,378; (f3) $29,721;
E. J. Hessell, West Falls, (f1) $219,287;
Myer & Myer Corp., Depew, (f2) $112,-267, (f3) $30,918, (f4) $24,317, (f5) $64,-053;
Greenfield Constr. Co., 89 Main St., Hornell, (f4) $23,195, (j) $31,853;
F. W. Knickenberg Contg. Co., 702 Michigan Ave., Buffalo, (f4) $24,552;
P. H. Murray, Cutler Bldg., Rochester, (f5) $59,884,
Rossney Contg. Co., Buffalo, (f5) $60,-405,
Dale Eng. Co., Mann Bldg., Utica, (f5) $63,697, (g2) $35,873;
E. J. Anderson & Co., Albany, (g1) $133,-060;
H. A. Schaupp, Inc., Albany, (g2) $34,-950;
D. I. Snell, Canajoharie, (g2) $36,333;
D. J. Phelan & Co., Utica, (h) $52,315;
Conroy & Nixdorf, Oneida, (i) $109,052;
Monroe Rds. Co., Pittsford, (j) $31,271;
Troup & Sherwood Co., Haverstraw, (k) $29,199;
J. L. Hayes Constr. Co., Inc., 53 South Bway, Yonkers, (k) $30,243;
D. W. Robbins, Inc., Utica, (m) $98,290;
P. D. Conley, Ithaca, (n1) $70,314;
F. J. Foote Co., Inc., Nunda, (f5) $65,-041, (n2) $131,440;
DeGraff & Hogeboom, Inc., Kingston, (e1) $44,742. Noted Aug. 21.

★**N. Y., New York**—H. Bruckner, pres. Bronx Boro., let contract paving East 239th St., to Uvalde Asphalt Paving Co., 1 Bway, $7089; East 170th St., to Asphalt Constr. Co., 2197 Madison Ave., $11,673. Noted Sept. 4.

New Jersey—State Highway Comn., Broad St. Bank Bldg., Trenton, received bids building 3865 sq.yd. State Highway Route No. 1, Sect. 1A, Metuchen Twp., Middlesex Co., concrete, from M. I. Demarest, Seawarren, $34,466; J. F. Burke, Plainfield, $38,602. Noted Aug. 28.

★**N. J., Bridgeton**—Comrs. Cumberland Co. let contract building 2 mi. Bridgeton-Fairton Rd., 20 ft. wide, to A. H. Lupton, Bridgeton, $17,213.

★**N. J., Trenton**—Bd. Freeholders Mercer Co. let contract repaving East State St. and Whitehead's Rd., sheet asphalt and vitr. brick on Portland cement concrete base, to J. J. Barrett, 147 Lafayette Ave., $53,099. Noted Aug. 28.

★**Pa., Pittsburgh**—City let contract grading, paving and curbing McCandless Ave. from 53rd to 56th Sts., to F. and F. Diulus, 40 Boundary St., $28,951. Work involves 2273 sq.yd. vitr. brick and 1592 sq.yd. stone block on 6 in. concrete base, 3000 lin.ft. concrete curbing and 11,006 cu.yd. earth excav. Noted Aug. 28.

★**Pa., Waynesburg**—Comrs. Greene Co. let contract building concrete and vitr. brick road from Dry Tavern on Waynesburg Rd., to E. E. Morris, Waynesburg, $319,732.

★**W. Va., Beckley**—Raleigh Co. let contract paving 8.5 mi. Giles, Fayette and Kanawha Turnpike, 9 ft. wide, penetration macadam with 3 ft. broken stone shoulder, to Vaughn Constr. Co., Williamson. About $90,000. County will furnish asphalt. Noted July 31.

★**W. Va., Harrisville**—Ritchie Co. will grade and drain 4 mi. Harrisville-Smithville Rd., 26 ft. wide. About $35,000. Work will be done by day labor. About July 17.

★**W. Va., Keyser**—Comrs. Mineral Co. let contract building Elk Dist. Rd., to H. W. Kaylor & Co., 106 Arcade Bldg., Hagerstown, Md. Work involves 49,000 cu.yd. unclassified excav., $1.10 per cu.yd., 1000 cu.yd. borrow excav., $1.00, 40,553 cu.yd. concrete pavement, $2.55, 40,553 cu.yd. bituminous surface, $1.05, etc., total cost, $247,626. Noted Aug. 21.

★**W. Va., Martinsburg**—Berkeley Co. let contract grading and surfacing 8 mi. Winchester-Martinsburg Turnpike, to R. R. Feller, Martinsburg. About $83,000. Noted Aug. 14.

★**W. Va., Moundsville**—City let contract improving Cedar Ave. from 1st to 3rd Sts., to Stringer & Springer, Wheeling, $11,000.

★**W. Va., Ft. Marys**—Pleasants Co. will improve 5.4 mi. River Rd., 22 ft. wide, involving 32,400 cu.yd. excav. About $10,-800. Work will be done by day labor.

★**W. Va., Wheeling**—City let contract paving Eoff St., to C. B. Kimberly Co., 909 Natl. Bank of West Virginia Bldg., $21,-896; 16th St., to Stringer & Springer, Wheeling, $33,207; North Huron St., to Jacovetti & Savage, Wheeling, $26,639. Noted Sept. 4.

★**Fla., Leesburg**—City Council let contract paving various streets 2 in. asphaltic concrete on 4 in. concrete, to Southern Road Bldg. Co., Tampa. About $134,000. Noted June 19.

Louisiana—State Highway Dept. received bids building 13.35 mi. Port Allen-New Roads Highway, West Baton Rouge Parish, from Pelican Constr. Co., $110,546, W. S. Bonner, $111,255, G. W. Prutsman, $111,-274; contractors all of New Orleans. Noted Sept. 4.

Ohio—State Highway Comn., Columbus, received bids Sept. 12, building roads in following counties:

Ashtabula Co., Sect. "B" Cleveland-Meadville Rd., 1.44 mi., smoothing present roadway and resurfacing with brick, Dorsey Constr. Co., Findlay, $41,674.

Columbiana Co., Sect. "E-1" Lisbon-Canton Southern Rd., .51 mi., grading and paving with waterbound macadam, Jones Constr. Co., Salem, and W. F. Payne, Springfield, $19,765 each.

Gallia Co., Sect. "E-2" Gallapolis-Ironton Rd., 1.015 mi., garding, constructing bridges and culverts and paving with bituminous macadam, Miller & Miller, Gallapolis, $23,168.

Harrison Co., Sect. "N-1" Cadiz-Carrollton Rd., 2.40 mi., grading, constructing bridges and culverts and paving with bituminous macadam, R. L. Timmons, Cadiz, $63,581; L. B. Wilson, Newark, $63,074.

Sect. "N-2" Cadiz-Carrollton Rd., .48 mi., grading, constructing bridges and culverts and paving with bituminous macadam, R. L. Timmons, $12,046; L. B. Wilson, $12,045.

Lawrence Co., Sect. "L" Ohio River Rd., 4.386 mi., grading, constructing bridges and culverts and paving with bituminous macadam, Mahl Bros., Ironton, $89,274.

Lorain Co., Sect. "Q" Milan-Elyria Rd., 1.21 mi., grading, building drainage structures and paving with rein.-con., Ohio Contg. Co., Elyria, $47,195; Elyria Constr. Co., Elyria $45,511.

Mercer Co., Sect. "G" St. Marys-Celina Rd., 5.49 mi., grading, building drainage structures and paving with plain concrete, J. Lynn, Paulding, $153,478; John Wroe, 605 U. B. Bldg., Dayton, $154,120.

Sect. St. Marys-Celina Rd., .25 mi., grading and paving with plain concrete, Joseph Lynn, and Studebaker & Sons, Greenville, $6,870 each.

Sect. "D-2" Celina-Wabash Rd., 1.672 mi., grading, constructing drainage structures and paving with plain concrete, M. L. Hinton, Celina, $51,709; G. H. Heffner & Sons, Celina, $52,098.

Montgomery Co., Sect. "P" Dayton-Indianapolis Rd., .39 mi., grading, building drainage structures and paving with semi-monolithic brick, Foster Reighert Constr. Co., Dayton, $24,595; Fink Eng. Co. 1533 Germantown St., Dayton, $24,859.

Sect. "C" Dayton-Germantown Rd., 3.35 mi., grading, building drainage structures and paving with rein.-con, Williams & Little Co., 2365 Euclid Heights Bldg., Cleveland, $83,842; E. Kemmerer, Dayton, $92,-717; bituminous macadam, C. W. Conley, Exton $94,910; J. C. McCann, 262 Midland Ave., Columbus, $99,868.

Noble Co., Sect. "D" Caldwell-Woodsfield Rd., 3.929 mi., grading, constructing bridges and culverts and paving with waterbound macadam, W. M. Gray, Bowling Green, $92,440.

Sect. "E" Caldwell-Woodsfield Rd., 2.814 mi., grading, constructing bridges and culverts and paving with waterbound macadam, W. M. Gray, $57,898.

Sect. "F" Caldwell-Woodsfield Rd., 2.719 mi., grading, constructing bridges and culverts and paving with waterbound macadam, W. M. Gray, $59,893.

Perry Co., Sect. "Q" Newark-New Lexington Rd., 1.73 mi., grading, constructing bridges and culverts and paving with bituminous macadam, W. M. Gray, $48,522.

Sect. "R" Newark-New Lexington Rd., 3.068 mi., grading, constructing bridges and culverts and paving with bituminous macadam, W. M. Gray, $77,264.

Pickaway Co.; Sect. "T-1" Columbus-Portsmouth Rd., .44 mi., grading, and paving with semi-monolithic brick, Mitchell & McDaniel, Columbus, $15,606; J. F. Perry & Son, Chillicothe, $15,996.

Ross County, Sect. "B-1" Dayton-Chillicothe Rd., 1 mi. grading, constructing bridges and culverts and paving with concrete, O. M. Junk, Chillicothe, $16,876; J. F. Perry & Son, $25,951; monolithic brick, O. M. Junk, $15,902; J. F. Perry & Son, $16,928.

Sect. "A-1" Dayton-Chillicothe Rd., grading, constructing bridges and culverts and paving with concrete, O. M. Junk, $22,759; Brewer & Brewer Sons, Chillicothe, $23,627; brick, O. M. Junk, $15,417; Brewer & Drewer Sons, $16,609.

Scioto Co., Sect. "A-2" Portsmouth-Jackson Rd., 2 mi. grading, constructing bridges and culverts and paving with monolithic brick, S. Monroe & Sons Co., Portsmouth, $57,770; Harper & Ruch, Portsmouth, $58,562.

Shelby Co., Sect. "F" Sidney-Wapakoneta Rd., 3.521 mi., grading, constructing bridges and culverts and paving with plain concrete, F. E. Milligan, Mt. Victory, $99,263; John Wroe, $100,918.

Sect. "G" Piqua-Sidney Rd., 3.065 mi., grading, constructing bridges and culverts and paving with plain concrete, F. E. Milligan, $91,990; C. W. Conley, Eaton, $92,554.

Tuscarawas Co., Sect. "F" Canton-Canal-Dover Rd., 1.47 mi., grading, constructing bridges and culverts and paving with bituminous macadam, Seipel & Wolfe Constr. Co., Youngstown, $38,579; J. C. McCann, $41,062.

Vinton Co., Sect. "D" McArthur-Gallapolis Rd., 3.62 mi., grading, constructing bridges and culverts, Ryan & Stone Constr. Co., Maumee, $22,822.

Warren Co., Sect. "D" Cincinnati-Columbus Rd., 4.05 mi., grading, constructing bridges and culverts and paving with waterbound macadam, Wilson Constr. Co., Xenia, and J. L. Raudebaugh, Montgomery, $64,590 each.

Wood Co., Sect. "A" Fremont-Perrysburg Rd., 3.48 mi., grading, constructing bridges and culverts and paving with bituminous macadam, Muldoon & Bergman, Gibsonburg, $71,871; Wire Bros. & Berman, Elmore, $72,513; bituminous macadam (A-1) Muldoon & Bergman, $69,921; Wire Bros. & Berman, $71,954.

Sect. "B" Fremont-Perrysburg Rd., 3.27 mi., grading, constructing bridges and culverts and paving with bituminous macadam, W. M. Gray, $62,933; Muldoon & Bergman, $61,582. Noted Aug. 28.

★**O., Cleveland**—City let contracts to Freshwater Paving Co., 11712 Detroit Ave., paving Henley Ave. from West 92nd to 99th Sts., cost $10,199, Nordica Ave. from West 73rd to 80th Sts., involving 18,950 sq.ft. 5 in. brick paving, $10,558. Noted Aug. 28.

★**O., Columbus**—G. A. Borden, dir. pub. serv., let contract resurfacing 2860 ft. St. Clair Ave. from Mt. Vernon Ave. to south end of viaduct, 30 ft. wide, asphalt, to A. G. Pugh, Columbus, $36,920. Noted July 31.

★**Mich., Detroit**—City let contract paving with sheet asphalt on 6 in. concrete foundation Medina curbstone, Epworth Blvd from Tireman to Dailey Aves., 46 ft. wide, less double track space, to W. B. Brady Const. Co., 1972 Grand River Ave., $58,759; Epworth Blvd from Warren to Tireman Aves., 46 ft. wide less double track space, Detroit Asphalt Paving Co., 20 McGraw Bldg., $56,016. Noted May 29.

Wisconsin—State Highway Comn., Madison, received bids improving County Line Rd., Dodge and Jefferson Counties, Federal Aid Project No. 72, involving (a) 15,474 cu.yd. earth excav., (b) 286 cu.yd. borrow excav., (c) 129 cu.yd. concrete in culverts, etc., from J. Finley, Janesville, (a) $87 per cu.yd., (b) $.87, (c) $25, total cost $20,344; P. W. Ryan & Sons, 214 Cherry St., Janesville, (a) $.85, (b) no bid, (c) $26, total, $21,355. Noted Sept. 11.

★**Wisconsin**—State Highway Comn., 601-602 Wilner Bldg., Green Bay, let contract improving Lake Shore Rd., Federal Aid Project No. 2, Manitowoc Co., to J. Young, Oconto, $52,189. Work involves 9624 cu.yd. earth excav., $.99 per cu.yd., 62 cu.yd. concrete in culverts, $24. 100 cu.yd. concrete bridges, $26. Noted Sept. 11.

★**Wisconsin**—State Highway Comn., La Crosse, let contract improving Fountain City-Winona Rd., Federal Aid Project No. 87, Buffalo Co., to Funk & Rasmussen, La Crosse, $49,890. Work involves 38,000 cu.yd. earth excav., $.54 per cu.yd. 2619 cu.yd. rock excav., $1.65. 133 sq.yd. concrete paving, $3. 227 cu.yd. concrete culverts, $27. Noted Sept. 4.

Streets and Roads (Continued)

★**Wisconsin** — State Highway Comn., Spooner, let contract improving Barron-Turtle Lake Rd., Federal Aid Project No. 101, Barron Co., to Swanson & Johnson, 5816 Oakes Ave., Superior, $48 797. Work involves 28,997 cu.yd. earth excav., $.70 per cu.yd., 5582 cu.yd. rock excav., $2, 476 cu.yd. concrete culverts, $26, 12 acres clearing and grubbing, $100. Noted Sept. 4.

★**Ia., Davenport**—Comrs. Scott Co. let contract to R. Condon, Omaha, Neb., paving Davenport-Durant Rd., $20,202; to Littig Constr. Co., 50 1st Natl. Bank Bldg., for 7514 cu.yd. earth excav., $4884, 335 cu.yd. macadam excav., $251 and 3200 yd. crushed rock, $4800.

★**Minn., Faribault**—Comrs. Rice Co. let contract to A. A. Guthrie & Co., 366 Jackson St., St. Paul, improving 5.5 mi. Federal Aid Project No. 77, 24 ft. wide, involving 48,732 cu.yd. excav., 6650 cu.yd. gravel surfacing, culverts, etc., $44,817, 4.3 mi. Federal Aid Project No. 69, 24 ft. wide, 15.894 cu.yd. excav., 5157 cu.yd. gravel surfacing, culverts, etc., $19,318; to J. E. McKillip, Faribault, 4.6 mi. Federal Aid Project No. 68, 24 ft. wide, 33,483 cu.yd. excav., 5600 cu.yd. gravel surfacing, culverts, etc., $22,746. Noted July 31.

★**Minn., Spring Valley**—City let contract paving 6655 sq.yd. road, creosote wood block, to Campbell Constr. Co., 3050 Hennepin Ave., Minneapolis, $40,000.

★**Montana**—State Highway Comn., Helena, let contract gravel surfacing 5 mi. Manhattan-No. 1 Ranch Rd., Gallatin Co., to N. Story, Bozeman, $47,115. Noted Aug. 14.

★**Mont., Billings**—City let contract building 44,000 sq.ft. sidewalk, to McElroy & Holmden, 105 North Bway., $10,405.

★**Ark., Ashdown**—Comrs. Little River Co. let contract building 8 mi. road, 8 ft. wide, in Dist. No. 7, involving 19,000 sq.yd. gravel, to J. G. Sanderson, Pine Bluff. About $126,000.

★**Ark., Helena**—Comrs. Phillips Co. let contract building 63 mi. Helena-Ferguson Rd., 6 in. concrete, 14 ft. wide, to J. A. Burt, Gunnison, Miss. About $1,900,000.

★**Ark., Little Rock**—Comrs. Northern Rd. Impvt. Dist., Arkansas Co., let contract building 75.9 mi. road to Miller-Butterworth Co., 621 South Trust Bldg., for Warrenite, cost $1,140,000; to Gregory & Wilson, Newport, for gravel, $414,000; Vincennes Bridge Co., Vincennes, Ind., for bridges, $83 000. Noted Aug. 21.

★**Okla., Bartlesville**—Comrs. Washington Co. let contract hard surfacing 15 mi. Bartlesville Highway, 18 ft. wide, concrete, to Western Paving Co., Terminal Bldg., Oklahoma. About $500,000.

★**Colorado**—State Highway Comn., Denver, let contracts paving 8.1 mi. Greeley-Denver Rd., Weld Co., 18 ft. wide, concrete, to Engineers Constr. Co., 807 7th St., Greeley, $22 000; 1.7 mi. Santa Fe Trail, Pueblo Co., 18 ft. wide concrete, Orman Constr. Co., Pueblo, $55,000; ⅛ mi. Longmont-Denver Rd., 18 ft. wide concrete, and ⅛ mi. Boulder Rd., 18 ft. wide, concrete, Boulder Co., to Colorado Bridge & Constr. Co., 306 Gas & Electric Bldg., Denver, $22 000 and $10,800 respectively. Noted Jan. 9.

★**Colo., Denver**—City let contract grading curbing and surfacing Harmon Impvt. Dist. No. 1, to J. V. Stryker, 2030 Welton Ave., cost $110,699; for sidewalks to R. M. Larson, 1309 Kalawath Ave., $45,023. Noted Sept. 3.

★**Ariz., Mesa**—City let contract paving Sect. 1 Tempe-Mesa Highway, 5 in. concrete pavement with 1½ in. bitulithic surface, to Southwestern Constr. Co., 13th Ave. and Lincoln St., Phoenix, $34,706; Sect. 2, 6 in. concrete pavement, near Mesa, to McElrath & Shumway, Mesa, $115,201. State will furnish cement.

★**Washington** — State Highway Bd., Olympia, let contract clearing, grading and draining 5.5 mi. Pacific Highway from Blanchard to Allen, Skagit Co., to Knutzen Bros., Burlington, $44,170; 1.9 mi. Pacific Highway from Marysville to Silvana, Snohomish Co., E. J. MacQuaid, 6556 3rd St., N. W., Seattle, $15,182; clearing, grubbing, draining and surfacing 6.7 mi. Pacific Highway from Castle Rock north, gravel, Cowlitz Co., H. McFee, Seattle, $241,318; 4 mi. North Bank Highway from Camas west, concrete, Clarke Co., Pacific Bridge Co., Salmon St., Portland, $142,874; 21.9 mi. Inland Empire Highway from Colfax to Central Ferry, crushed rock, Whitman Co., Ristvedt, Bragg Co., Colfax, $215,760; 7.8 mi Central Washington Highway, from Cheney to Tyler, crushed rock, Spokane Co., Genl. Constr. Co., 1324 Elm St., Spokane, $82,505. Noted Aug. 14.

★**Wash., Colville**—Town Council let contract paving 4 blocks and building 8 mi. cement sidewalks on Main and 1st Sts., to W. J. Doust, 1034 Indiana St., Spokane, $22,787.

★**Wash., Ritzville**—Comrs. Adam Co. let contract grading, draining and surfacing 12½ mi. Donohue Rd. No. 3, involving 109,139 cu. yd. earth and 4599 cu. yd. rock excav., and 22,304 cu. yd. crushed rock, to R. A. Sloan, Seattle, $131,274; 8½ mi. Donohue Rd. No. 4, 70 cu. yd. concrete, 18,058 cu. yd. earth excav. and 15,162 cu. yd. crushed gravel, to W. J. Smith & Co., Ritzville, $45,510. Noted Aug. 28.

★**Wash., Waterville**—Comrs. Douglas Co. let contract grading, draining and graveling 16 mi. L. I. D. Rd. No. 4, Sect. 2, near Withrow, to Mohr Constr. Co., Spokane, $91,000; 7½ mi. L. I. D. Rd. No. 4, near Waterville, to S. G. Kinder, Spokane, $56,000. Noted Aug. 21.

★**Ore., North Powder**—City let contract building new concrete crossings and sidewalks, to Newton Bros. Cost to exceed $10,000.

Ore., Portland—Comrs. Multnomah Co. received bids Aug. 25, clearing, grubbing, grading, laying drainage pipes and building 5100 ft. Hospital Rd. No. 938, (1) iron pipe, (2) concrete pipe, from Western Constr. Co., Portland, (1) $31,620, (2) $31,681; Baker Bros., Portland, (1) $37,731, (2) $37,863; R. L. Ray, Portland, (1) $38,321, (2) $38,178. Noted Aug. 21.

California—State Highway Comn., Forum Bldg., Sacramento, received bids building Sect. B, Route 13, Div. 3, Federal Aid Project No. 27, Stanislaus Co., from Palmer & McBryde, Hooker-Lent Bldg., San Francisco, $157,943, Bates & Borland, Oakland Bank of Savings Bldg., Oakland, $196,119, G. S. Benson & Son, Stimson Bldg., Los Angeles, $198,325; Sect. B, Route 2, Div. 7, Federal Aid Project No. 24, Orange Co., G. R. Curtis, 2440 East 26th St., Los Angeles, $86 551; Fairchild-Gilmore, Wilton Co., 610 South Main St., Los Angeles, $101,949; Los Angeles Paving Co., Inc., 2900 Santa Fe St., Los Angeles, $105,243; Sect. G, Route 1, Div. 1, Federal Aid Project No. 18, Humboldt Co., Mercer-Fraser Co., Eureka, $150,476. Noted Aug 28.

★**California**—State Highway Comn., Sacramento, rejected bids paving 10.7 mi. road through Tejon Pass, near Rose Station, Kern Co. About $214,400. Work will be done by day labor. J. B. Woodson, Fresno, div. engr.

★**Cal., Bakersfield**—City let contract improving 17th, Q, Cedar, K Sts. et al, to Federal Constr. Co., Call Bldg., San Francisco, $100,000. Work involves surfacing at $.01 per sq.ft., 3 in asphaltic concrete base with 1½ in. bitulithic surface, $.19 sq.ft., concrete gutters, $.25 per sq.ft., cement sidewalks, $.17 sq.ft. and concrete curbs, $.40 per lin.ft. Noted Apr. 24.

Cal., Los Angeles—City received bids grading and paving with 4 in. concrete 2600 ft. Coast Blvd., 20 ft. wide, from W. D. McCray, 424 Amer. Bank Bldg., $24,340; W. Liddington, 460 West 68th St., $24,730; Fairchild-Gilmore-Wilton Co., Pacific Electric Bldg., $33,100.

★**Cal., Martinez**—Bd. Supervs. Contra Costa Co. let contract paving 3 mi. Div. 14 county highways between Knightsen and Oakley, concrete, to Blanchard, Crocker & Howell, 58 2nd St., San Francisco, $83,616. Noted Aug. 21.

★**Cal., Porterville**—See "Railways" under California.

Railways

PROPOSED WORK

Ohio—Cleveland Ry., Leader News Bldg., Cleveland, receives bids about Sept. 30, building 3 mi. single track electric line on Ridge Rd. from Dennison Ave. to Big Creek. About $200,000. A. McKay, ch. engr.

Nevada—Tonopah-Divide & Goldfield Electric Ry. Co., Tonopah, organized by C. Stout, Reno, and others, plans to build 6 mi. electric railroad from Pevert claim to Tonopah. R. W. Cattermole, Goldfield, ch. engr.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★**California**—Atchison, Topeka & Santa Fe Ry., Kerckhoff Bldg., Los Angeles, let contract building 15 mi. line from Porterville to Tucor to Sharp & Fellows Contg. Co., Central Bldg., Los Angeles. Work involves heavy grading, pile trestles, concrete culverts, etc.

Excavation and Dredging

PROPOSED WORK

Wash., Woodland — Irrigation — Comrs. Cowlitz Co. plan to build irrigation system to reclaim 1200 acres between Lewis River and railway, in Diking Dist. No. 11. About $50,000. G. J. Poysky, Kelso, engr.

Cal., Oxnard—Ditches—Oxnard D. D. voted $200,000 bonds to build open ditches and pipe drains. Olmsted & Gillelen, 1112 Hollingsworth Bldg., Los Angeles, engrs. Work will probably be done by day labor. Noted Aug. 14.

BIDS DESIRED

N. Y., Marcy—Excavation—Until Sept. 24, by State Hospital Comn., Capitol, Albany, preparing subgrade of spur track involving 22,000 cu.yd. excav., 35 cu.yd. 2nd Class concrete, 15,000 lb. c.i. pipe laid, 1000 lb. metal reinforcement, etc., for Marcy Hospital, here. About $23,155.

Ind., Greenfield—Drainage—Until Oct. 4 by C. Haskett, supt. construction, Hancock Co., building John T. Collins Drain, involving 29,789 ft. 10-30 in. tile drain. C. Boone, Greenfield, engr.

Wis., Sheboygan — Excavation — Until Sept. 21, by J. Donohue, engr., York Bldg., excavating and installing 7500 ft. 8-10 and 12 in. tile drain, for Sheboygan Co. About $15,000.

Minn., Benson—Ditch—D. P. Carney, aud., Swift Co., receiving bids building Ditch No. 19, involving 53,600 ft. 5-20 in. tile. About $15,397.

Minn., Ivanhoe—Ditches—A. L. Swenson, aud., Lincoln Co., receiving bids building Co. Ditch No. 40, involving 13,453 yd. open ditching, No. 42, 32,405 yd. open ditching, cleaning Job No. 7, 7638 yd. open ditching and 2000 ft. tile. About $67,000. E. Haygun, Ivanhoe, engr.

Minn., Olivia—Until Oct. 7, by A. O. Schmidt, aud., Renville Co., building Ditch No. 75. About $115,889. F. M. Shepherd, Olivia, engr.

Ark., Marianna — Dredging—Until Sept. 23, by Daggett & Daggett, engrs., Marianna, building 22 mi. floating dredge work in Black Swamp D. D., Lee Co., involving 650,000 cu.yd. excav.

Ark., Marianna—Dredging—Until Sept. 23, by Comrs. Larkin Creek D. D., at office of Daggett & Daggett, Marianna, building 8½ mi. floating dredge work, involving 214,000 yd. excav.

Ark., Marianna—Dredging—Until Sept. 23, by Comrs. Lee-Phillips D. D., at office of Daggett & Daggett, Marianna, building 30 mi. floating dredge work, involving 1,905,000 cu.yd. excav.

Cal., Colusa—Levee—Until Sept. 26, by Trustees Sacramento River West Side Levee Dist., 858 Mills Bldg., San Francisco, building and raising levee, (floating dredgework). About $50,000. F. H. Tibbetts, Alaska Commercial Bldg., San Francisco, engr.

N. B., St. John—Dredging—Until Sept. 23, by Dept. Pub. Wks., Ottawa, Ont., dredging here. About $125 000. K. M. Cameron, c/o Dept. Pub. Wks., engr.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract

★**Conn., Bridgeport** — Excavation — See "Miscellaneous."

★**Iowa, Avoca**—Drainage—D. D. No. 15 let contract building 5 mi. drainage ditches involving 400,000 yd. dry excav., to S. O. Briggs Co., 925-7 City Natl. Bank Bldg., Omaha, Neb., $.11 per yd. Total cost $44,000.

★**Minn., Faribault** — Excavation — See "Streets and Roads."

Utah, Fillmore—Drainage—Bd. Supervs. Millard Co. received bids furnishing labor and matarials building (a) system in D. D. No. 1, (b) D. D. No. 4, from C. Thompson, Omaha, Neb., (a) $208,067, (b) $38,023; Heussen & Packard, Atlas Bldg., Salt Lake City, (a) $241,432, (b) $464,105. Noted Aug. 14, under Hinckley.

Utah, Salt Lake City—Drainage—Brighton D. D. No. 1, Salt Lake Co., received bids furnishing labor and materials improving system, from Heussen & Packard, Atlas Bldg., $150,115; C. Thompson, Omaha, Neb., $175 065. Noted July 24.

Industrial Works

PROPOSED WORK

Vt. Swanton—Park & Pollard Co. plans to build brick and concrete grain elevator to replace one recently destroyed by fire. About $60,000. Architect not selected.

Indusrial Works (Continued)

Mass., Great Barrington—Stanley Insulating Co. plans to build 2 story brick and mill construction addition to factory. About $35,000. Private plans.

Mass., Worcester—J. N. Maguire Co., 745 Boylston St., Boston, having plans prepared by Appleton & Stearns, archts., 53 State St., Boston, for brick and rein.-con. garage, sales and service building, on Park Ave. About $60,000.

Mich., Filer City—Manistee Drop Forge Co., Manistee, purchased site and plans to build rein.-con., brick and steel plant, here. C. G. Briggs, secy. Architect not selected.

R. I., Providence—Arpin, Avila & Adolh, 33 Appleton St., having plans prepared for 1 story brick, concrete and steel garage, rein.-con. flooring, concrete foundation, on Manton Ave. and Cyril St. About $25,000. Private plans.

R. I., Providence—General Baking Co., 207 Brook St., having plans prepared by J. E. Byrne, archt., 45 East 17th St., New York City, for brick and rein.-con. bakery, on John and William Sts. About $150,000. Noted July 31.

R. I., Riverpoint—Royal Mills plans to build 3 story, 150 x 500 ft. weave shed and rebuild old spinning mill. About $500,000.

Conn., Hartford—H. Dragat, 340 Windsor Ave., having plans prepared by G. Zunner, archt., 756 Main St., for 2 story, 50 x 72 ft. mill construction warehouse, rein.-con. flooring.

Conn., New Haven—Alper, Krall & Co., 44 Crown St., soon lets contract building 4 story, 83 x 100 ft. brick and mill construction factory, concrete foundation, on Greene and Olive Sts. About $75,000. Brown & Von Beren, 185 Church St., archts. Noted July 31.

Conn., West Haven (New Haven P. O.)—New Haven Machine Co., 179 Milford Turnpike, Allingtown, soon receives bids building 2 story, 44 x 100 ft. brick and mill construction shop, concrete foundation on Milford Turnpike. About $25,000. Private plans.

N. Y., New York—M. Hausle, engr. and archt., 3307 3rd Ave., preparing plans for asphalt plant, 2 story, rein.-con., brick and steel, rein.-con flooring, concrete foundation. About $100,000. Owner's name withheld.

N. Y., New York—Hoover Letter Serv., Inc., 387 4th Ave., having plans prepared by V. C. Farrar, archt. and engr., 4 East 39th St., for altering 5 story, brick and steel garage, rein.-con. flooring, at 117 West 46th St. About $25,000

N. Y., Watertown—Watertown Silk Mfg. Co., 35 Fairbanks St., plans to build 2 story, 60 x 180 ft. brick factory, concrete foundation, on Hamilton and Central Sts. About $50,000. Engineer not selected.

Pa., Phila.—Amer. Preserve Co., 946 Beach St., having plans prepared by Peuchert & Wunder, archts. and engrs., 310 Chestnut St., building 5 story, 80 x 250 ft. brick factory and 1 story, 50 x 70 ft. boiler house, on 3rd and Lehigh Sts.

Pa., Phila.—W. F. Koelle & Co., archts., 26th and Oxford Sts., rejected bids building 7 story, 49 x 186 ft., rein.-con. and brick ice cream plant on 8th and Cumberland S'ts., for Breyer Ice Cream Co. Noted Aug. 14.

Pa., Phila.—J. W. Vandergrift, care of Clark & Dudnick, archts., Drexel Bldg., soon receives bids building 2 story, 57 x 175 ft., brick garage on 12th and Cambria Sts. About $50,000.

Md., Frederick—Fiber Co. of North America, McLachlen Bldg., Wash., D. C., plans to build linen fiber factory, here. Address J. M. Thomas, Frederick.

N. C., Southport—Cape Fear Fish Fertilizer Co., plans to build 1 story, 125 x 300 ft. plant. About $250,000.

La., Winnfield—Winn Parish Lumber Co. plans to build mill. About $500,000. J. S. Welsh, Shreveport, secy.

O., Cleveland—Cleveland & Sandusky Brewing Co., Amer. Trust Bldg., plans to build 2 story, 100 x 170 ft. rein.-con., steel and brick addition to bottling plant, on East 55th St. About $100,000. Architect not selected.

O., Cleveland—Federal Packing Co., East 4th St., plans to build 4 story, 40 x 115 ft. rein.-con., steel and brick cold storage plant. About $100,000. Architect not selected.

O., Cleveland—Fink Body & Fender Co., 2075 East 65th St., preparing plans for 2 story, 62 x 101 ft., rein.-con., steel and brick factory and repair shop. About $60,000.

O., Cleveland—F. A. Foyer, Schofield Bldg., having plans prepared by G. S. King, archt., Permanent Bldg., for 6 story, 88 x 95 ft., rein.-con., steel and brick garage and sales room, at 1341 Chestnut St. About $50,000.

O., Cleveland—S. Levin, 2407 East 46th St., plans to build 2 story, 116 x 139 ft., rein.-con., steel and brick garage, on Warren Rd. About $50,000. Architect not selected.

O., Cleveland—Pioneer Mfg. Co., East 103rd St. and Harvard Ave., plans to build 2 story, 170 x 200 ft., rein.-con., steel and brick factory, at 3053 East 82nd St. About $50,000. Architect not selected.

O., Cleveland—Western Electric Co., 413 Huron Rd., plans to build 6 story, 100 x 100 ft., rein.-con., steel and brick, warehouse and office, on Carnegie Ave. About $125,000. Architect not selected.

O., Cleveland—White Motor Car Co., East 79th St., preparing plans for 1 story, 200 x 600 ft., rein.-con., steel and brick addition to factory. About $600,000.

O., Cleveland—Zenith Tire & Rubber Co., Schofield Bldg., having preliminary plans prepared by A. W. Harris, archt., Schofield Bldg., for plant on Euclid Ave., to include several 1 story, rein.-con., steel and brick buildings. About $10,000,000.

O., Dayton—Sun Co., Woodville St. and Belt Ry., Toledo, plans to build 2 story, 100 x 130 ft., brick warehouse, brick foundation, on Wampum St., here. About $60,000. Architect not selected.

O., Delphos—Amer. Road & Mchy. Co had plans prepared for large addition to plant. Cost including equipment, $300,000.

O., Mount Vernon—Knox Tire & Rubber Co. having plans prepared by Osborn Eng. Co., engrs., 2848 Prospect Ave., Cleveland, for 2 story, 90 x 200 ft., rein.-con., steel and brick factory and office. About $100,000.

O., Wooster—Buckeye Aluminum Co. having preliminary plans prepared for factory. About $125,000.

Mich., Bay City—J. P. Beck, 201 South 2nd St., Saginaw, having plans prepared by R. E. Bickell, archt., Bay City, for 3 story, 100 x 100 ft., rein. con., brick and steel garage, store room and office, rein. con. flooring, concrete foundation, on Washington St., here. About $60,000. Noted Aug. 21.

Mich., Detroit—H. S. Angell, archt., 722 Free Press Bldg., preparing plans for 2 story, 31 x 132 ft. rein.-con. and brick factory, rein.-con. flooring, concrete foundation, on Jones St. About $30,000. Owner's name withheld.

Mich., Detroit—General Ice Delivery Co., Grand River Ave., having plans prepared by D. R. Wells, archt., 435 Woodward Ave., for 1 story, 36 x 322 ft. brick, frame and tile storage plant, rein.-con. flooring, concrete foundation on Warren Ave.

Mich., Detroit—H. M. Lane Co., engrs., 701 Owen Bldg., receives bids about Sept. 25 building 1 story, 100 x 200 ft., concrete and steel foundry, rein. con. flooring, concrete foundation, on Herrick St. and Vernor Ave., for Monarch Fdry. Co., 895 Greenwood Ave. Noted Sept. 11.

Mich., Detroit—Mildner & Eisen, archts., 924 Hammond Bldg., receives bids about Sept. 20, for 2 story, 60 x 100 ft., rein.-con., brick and steel factory, rein.-con. flooring, concrete foundation, on Mack Ave., for Tivoli Brewing Co., 1555 Mack Ave.

Mich., Detroit—J. L. Miller, archt., 15 Goeble Bldg., preparing plans for 2 story, 43 x 100 ft., brick, steel and stone factory, rein. con. flooring, concrete foundation, on Milwaukee Ave. and Orleans St. About $35,000. Owner's name withheld.

Mich., Filer City—Manistee Drop Forge Co., Manistee, purchased site here, and plans to build rein.-con., brick and steel plant. C. G. Briggs, secy. Architect not selected.

Mich., Flint—Champion Ignition Co. soon lets contract building 3 story, 108 x 178 ft., rein.-con., brick and steel factory, rein.-con. flooring, concrete foundation, on Industrial Ave. and Harriet St.

Mich., Port Huron—Chief Motor Co. purchased 10 acre site on Elmwood St. and plans to build large plant. H. S. Erd, mgr. Architect not selected.

Mich., Saginaw—Cooper & Beckbissinger, archts., 114 South Jefferson St. receive bids about Sept. 20, building 4 story, 100 x 120 ft. brick, steel and concrete factory, concrete foundation. Owner's name withheld. Noted Sept. 11.

Ill., Chicago—P. Gerhardt, archt., 64 West Randolph St., soon receives bids building 2 story, 25 x 180 ft. rein.-con., steel and terra cotta addition to press room and offices, rein.-con. flooring, concrete foundation, at 316 West Madison St., for Illinois Publishing Co., Hearst Bldg. About $100,000.

Ill., Chicago—W. R. Johnston Mfg. Co., 359 East Ohio St., acquired 150 x 750 ft. site on Schubert and Fullerton Aves. and plans to build factory. About $100,000. Architect not announced.

Wis., Fairchild—Wisconsin Canned Food Co. plans to build 4 story, 90 x 150 ft. rein.-con. and brick factory, rein.-con. flooring, brick foundation, on Main St. About $40,000. Architect and engineer not selected.

Wis., Ft. Atkinson—James Mfg. Co. plans to build 1 story, 400 x 500 ft. brick, tile and steel factory, rein.-con. flooring, brick foundation. About $100,000. J. G. Shodron, Ft. Atkinson, archt. and engr.

Wis., Hartford—City having plans prepared by Cahill-Douglas, archts., Gross Bldg., Milwaukee, for 1 story, 60 x 110 ft. brick, rein.-con. and steel power plant, rein.-con. flooring, brick foundation. Cost between $50,000 and $60,000.

Wis., Sheboygan—Globe Fdry. Co., 9th St., plans to build 2 or 4 story, 60 x 250 ft. brick, rein.-con. and steel foundry, rein.-con. flooring, brick foundation, on Wildwood Ave. and 18th St. About $60,000. Architect and engineer not selected.

Ia., Waverly—Iowa Sugar Co. plans to build warehouse and pulp mill, both 3 story, 50 x 100 ft., concrete and steel, concrete foundation. About $700,000. Architect and engineer not selected.

Neb., Omaha—Omaha Flour Mills Co., 820 1st Nat'l. Bank Bldg., plans to build 7 story mill. About $600,000. Architect not selected.

Mo., St. Louis—Certain-t-eed Products Corp., Boatmen's Bank Bldg., soon receives bids building 4 story, concrete and brick factory on Union Ave. About $100,000. E. C. Taxis, engr., and Klipstein & Rathman, archts., both in Chemical Bldg.

Mo., St. Louis—Genl. Motors Co., Union and Natural Bridge Rds., plans to build storage houses, sheds and railway tracks at $3,000,000 factory now under construction, also vitr. brick and concrete driveway and road section on Natural Bridge Rd. near Union Rd. About $75,000. W. H. Kilpatrick, c/o owner, engr.

Tex., Wich'ta Falls—Ft. Worth & Denver R. R., Ft. Worth, plans to build 2 story, concrete freight station. About $200,000. R. C. Gowdy, 1420 Washington Ave., Ft. Worth, ch. engr.

Ariz., Phoenix—Arizona Fruit & Storage Co. having plans prepared by Shepard & Hamm, archts. and engrs., Central Bldg., Pasadena, Cal., for 90 x 160 ft., rein.-con. and brick packing plant, concrete foundation. About $50,000.

Wash., Chelan Station (Chelan P. O.)—Orchard Co. plans to build warehouse, 3 story, 60 x 100 ft., brick and hollow tile, concrete foundation, to include packing rooms, storage and shipping facilities, etc. About $50,000. Private plans.

Wash., Fairview (Seattle P. O.)—A. Kristoferson Co., Fastlake Ave., plans to build milk plant 2 story, 100 x 100 ft., concrete, concrete foundation, to include refrigerating plant, mechanical carriers, elevators, power and compressed air plants, etc. About $50,000, exclusive of equipment. E. Story, New York Blk., Seattle, archt.

Wash., Leavenworth—Pelshastin Lumber Co. plans to rebuild box factory and saw mill, concrete and frame. About $75,000. Private plans.

Ore., Bend—Bend Water, Light & Power Co. plans to build 1000 k.w. steam plant to double present power output. About $100,000. T. H. Foley, Bend, mgr.

Ore., Corvallis—Whiteside & Locke Hardware & Implement Co., purchased site on 3rd and Madison Sts. and plans to build 2 story, 50 x 100 ft. brick addition to plant. About $50,000. Private plans.

Ore., Myrtle Point—L. H. Pearce purchased site east of present property and plans to build 1 story, 90 x 100 ft. cement addition to garage. About $55,000. Architect not selected.

Ont., Cornwall—Firestone Tire & Rubber Co. South Main St., Akron, O., plans to build 3 story, factory here, probably concrete or steel. About $200,000. Engineer not selected.

Indusrial Works (Continued)

Cal., Chino—Libby, McNeil & Libby, 38 South Dearborn St., Chicago, purchased cannery here and plans to build 2 or 3 story rein.-con. addition, cost, $100,000 also spend $250,000 for other buildings and machinery.

Cal., Long Beach—Trident Packing Co. plans to take over plant of Pacific Packing Co. and build refrigeration and cold storage plants. About $50,000.

Cal., Oakland—Pacific Coast Shredded Wheat Co. 14th and Union Sts., having plans prepared by J. S. Bogart, archt., Mills Bldg., San Francisco, for 8 rein. con. wheat elevators with 100,000 bu. capacity. About $100,000.

Cal., Pasadena—Warnerlite Co., 45 South Raymond Ave., having plans prepared by Shepherd & Hamm archts. and engrs., Central Bldg., for 1 story, 260 x 300 ft. factory and 1 story, 80 x 100 ft. administration building with two 60 x 80 ft. wings, rein.-con. and brick, concrete foundation, on Marengo Ave. About $100,000. Noted Aug. 21.

Sask., Melville—Grand Trunk Pacific Ry., McGill St., Montreal, Que., plans to build electric power plant here. About $110,000. H. R. Safford, ch. engr.

BIDS DESIRED

Conn., Bridgeport—See "Buildings."

N. Y., Marcy—Until Oct. 7, by State Hospital Comn., Capitol, Albany, for 1 story, 65 x 280 ft. central heating plant and 1 story, 80 x 120 ft. boiler room brick and steel, concrete foundation, for Utica State Hospital, Marcy Division, here. Equipment includes three 500 hp. boilers, 2 fan blowers, one 125 kw. and one 75 kw. generators, pumps, meters, complete coal and ash handling equipment, motors, etc. About $500,000; advertised in this issue.

Pa., Pittsburgh—S. A. Maxwell & Co. receiving bids constructing 9 story, 52 x 88 ft. rein.-con. wholesale building, concrete foundation, on Isabella and Sandusky Sts. Hunting-Davis Co., Century Bldg., archts. Noted Aug. 21.

O., Canton—Canton Ice Delivery Co., Massillon, receiving bids building 1 story, 80 x 90 ft., rein.-con., steel and brick storage plant, on Navarre St., here. About $100,000. A. C. Bishop, Guardian Bldg., Cleveland, archt.

O., Cleveland—City Ice Delivery Co., 1935 Euclid Ave., receiving bids constructing 1 story, 100 x 140 ft., rein.-con., steel and brick storage building, on Euclid Ave. About $60,000. Private plans.

O., Cleveland—Cleveland Ry., Leader-News Bldg., receiving bids building 5 story, 49 x 80 ft., rein.-con., steel, terra cotta and brick sub-station at 13006 Woodland Ave. About $50,000. C. H. Clark, engr.

O., Cleveland—Cream Cone Mchy. Co., 5454 Hough Ave., receiving bids building 2 story, 54 x 54 ft., rein.-con., steel and brick factory, at 5808 Hough Ave. About $30,000. Private plans.

O., Cleveland—Cross Candy Co., 1966 East 66th St., receiving bids building 1 story, 47 x 140 ft., rein.-con., steel and brick factory, at 6509 Hough Ave. About $75,000. Private plans.

O., Cleveland—G. S. Ryder, archt., Century Bldg., receiving bids building 1 story, 91 x 161 ft., rein.-con., steel and brick addition to factory, for Par Brook Co., Brook Park Rd. About $25,000.

O., Cleveland—White Motor Car Co., East 79th St., receiving bids building 2 story, 210 x 884 ft., rein.-con., steel and brick machine shop. About $175,000. Private plans.

O., Columbus—W. S. Ferguson Co., archts., 1900 Euclid Ave., Cleveland, receiving bids building 2 story, 63 x 183 ft. rein.-con., steel and brick garage, on Gay St., for Columbus Oldsmobile Co., 134 Gay St. About $60,000.

Mich., Detroit—Brown & Preston, archts., 406 Empire Bldg., receiving bids for 2 story, 65 x 100 ft., brick and steel addition to bakery, rein.-con. flooring, concrete foundation, on 4th St. and Merrick Ave., for Mille-Fox Baking Co., 4th St. and Merrick Ave. About $30,000. Noted Sept. 11.

Mich., Detroit—A. Kahn, archt., Marquette Bldg., receiving bids for 1 story, 275 x 528 ft., rein. con., brick and steel factory, rein. con. flooring, concrete foundation, for Paige Detroit Motor Car Co., McKinstry and Fort Sts., W.

Wis., Edgarton—Until Sept. 27, by Continental Axle Co., building 2 story, 60 x 275 ft. brick, rein.-con. and steel factory, rein.-con. flooring, brick foundation, on Main St. About $50,000. Private plans.

Minn., West Duluth (Duluth P. O.)—Duluth Showcase Co., West Superior St., Duluth, receiving bids for 3 story, 75 x 285 ft., concrete and steel factory at 2800 West Superior St. About $150,000. A. Puck, Torrey Bldg., Duluth, archt. Noted Sept. 4.

Okla., Muskogee—O. T. Grahm, 16th St. and Emporia Ave., receiving bids building 1 story, 100 x 100 ft., rein.-con. steel and brick garage, rein.-con. flooring, concrete foundation. About $50,000. H. O. Valeur & Co., 705 Phoenix Bldg., archts.

Que., Cap de la Madeleine—Until Sept. 27, by Tidewater Shipbuilders Ltd., Three Rivers, building 2 story, 40 x 62 ft., steel and brick machine shop, concrete foundation, on river front here. About $50,000 M. Mapes, Canadian Pacific Ry. Bldg., Windsor Sta., Montreal, archt.

Sask., Melville—Until Sept. 24, by Sask. Co-operative Creamery Co., Regina, building 3 story, 47 x 50 ft., concrete, brick and steel creamery. About $60,000. Poole Constr. Co., Smith St., archts.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract

★**Mass., Boston**—E. N. Weyner let contract building 3 story, 60 x 175 ft. rein.-con. garage, at 1001 Commonwealth Ave., to N. Hurwitz. About $100,000.

★**Mass., Lowell**—Massachusetts Cotton Mills Canal St., let contract building rein.-con. and brick power plant, rein.-con. flooring, concrete foundation, to H. P. Cummings Constr. Co., 14 Prospect St., Ware. About $200,000.

★**Mass., New Bedford**—Natl. Spun Silk Co., Bullard St., let contract building 1 story rein.-con. power house., rein.-con. flooring, concete foundation, to J. G. White Eng. Co., 43 Exchange Pl., New York City. About $100,000.

★**Mass., New Bedford**—New Bedford Storage Warehouse Co., School and Water Sts., will build 6 story rein.-con. addition to warehouse, rein.-con. flooring, concrete foundation. on School St. About $75,000. Work will be done by day labor.

★**Mass., Thorndike**—Leary & Walker, engrs., Purchase St., New Bedford, let contract to J. J. Prindiville Co., 59 Concord St., Framingham, building 6 story, 75 x 163 ft. brick and concrete mill, rein.-con. flooring, concrete foundation, for Thorndike Co. About $175,000. Noted Sept. 11.

★**Mass., Worcester**—Coppus Eng. & Equipment Co., Inc., Park Ave., let contract building 1 story, brick, concrete and steel addition to foundry, rein.-con. flooring, concrete foundation, to G. W. Carr Co., 518 Main St. About $80,000. Noted Aug. 28.

★**Mass., Worcester**—Worcester Paper Box Co., 68 High St., will build 2 and 4 story, brick and rein.-con. garage, rein.-con. flooring, concrete foundation, on Austin St. About $100,000. Work will be done by day labor. Noted Aug. 14.

★**R. I., Pawtucket**—Darlington Textile Co., 48 Hughes Ave., let contract building 1 story, 50 x 100 ft. brick and mill construction weave shed, rein.-con. flooring, concrete foundation, to F. G. Rowley Co., 260 Central Ave. About $25,000.

★**R. I., Pawtucket**—Ervma Weaving Co., 30 Bayley St., let contract building 1 story, 90 x 114 ft. brick and mill construction weave shed, rein.-con. flooring, concrete foundation, on Privet St., to F. G. Rowley Co., 260 Central Ave. About $30,000.

★**Conn., New Haven**—New Haven Stove Repair Co., 488 State St., will build 1 story, 60 x 105 ft. brick and steel garage, rein.-con. flooring, concrete foundation, on State St. About $25,000. Work will be done by day labor under supervision of J. Weinstein, archt., 6 Church St. Noted Aug. 21.

★**Conn., New Haven**—Texas Oil Co., 17 Battery Pl., New York City. will build 1 and 2 story, 38 x 100 ft. storage and office and 1 story, 40 x 56 ft. garage, rein.-con., rein.-con. flooring, concrete foundation, on Forbes Ave. About $35,000. Work will be done by day labor. Noted Aug. 14.

★**Conn., Waterbury**—F. A. Webster, archt., 51 West Main St., let contract to Tidewater Bldg. Co., 16 East 33rd St., New York City, constructing 1 story, 50 x 50 ft. shop, 2 story, 50 x 120 ft. foundry and 1 story, 100 x 100 ft. storage building, brick, rein.-con. flooring, concrete foundation, on Railroad Hill, for Manufacturers Fdry. Co. About $60,000. Noted Sept. 11.

★**N. Y., Hempstead**—Borden Farm Products Co., Main St., let contract building 1 story, 30 x 180 ft., brick and steel distributing plant, rein.-con. flooring, concrete foundation, to Miller-Reed Co., 103 Park Ave., New York City.

★**N. Y., New York**—J. Cohen, 243 Penn St., Brooklyn, will build 1 story, 80 x 98 ft. brick and steel garage, rein.-con. flooring, brick foundation, at 233 West 25th St., here. About $40,000. Work will be done by day labor.

★**N. Y., New York**—A. M. Fleming, 612 5th Ave., will build 2 story, 100 x 100 ft. brick and steel garage, rein.-con. flooring, brick foundation at 236 East 55th St. About $35,000. Work will be done by day labor.

★**N. Y., New York**—J. P. Stanley, 30th St. and North River, let contract altering and building 3 story, 100 x 175 ft. brick and steel addition to warehouse, to Fanning-Quinn, 105 West 40th St. About $100,000.

★**Pa., Carbondale**—Carbondale Machine Shop, Simpson St., let contract building 1 story, 80 x 220 ft., steel and hollow tile, machine shop, to Hughes-Foulkard Co., Commonwealth Trust Bldg., Phila. About $60,000.

★**Pa., Sharon**—N. Rosenblum, 83 Shenango St., let contract building 2 story warehouse on Pitt St., to Wallis & Carley, Bank St. About $100,000.

★**Md., Baltimore**—G. R. Callis, Jr., archt. Melvin Ave., Cantonville, let contract to West Constr. Co., 907 Amer. Bldg., for 5 story, 83 x 197 ft., rein.-con. and brick warehouse, concrete foundation, for Genl. Coffee & Tea Co., Light and Lee Sts. About $140,000. Noted Aug. 28.

★**D. C., Washington**—Hill & Tibbits, 1407 H St., N. W., let contract building 3 story, 100 x 100 ft., rein.-con. and brick garage and show room, on 14th and Ohio Sts., N. W., to R. P. Whitty, Union Trust Bldg. About $50,000.

★**N. C., Greensboro**—McGlanery Auto Co. let contract building 2 story, 85 x 200 ft. concrete garage, on Ashe St., to J. B. Couse, Greensboro. About $140,000.

★**N. C., Statesville**—Statesville Coco Cola Co. let contract building 2 story, 50 x 90 ft. brick plant, to F. Lawrence, Statesville. About $200,000.

★**Ala., Opelika**—Opelika Cotton Co. let contract building addition to mill, to Fiske-Carter Co., Greenville, S. C. About $100,000.

★**O., Cleveland**—Holam Mfg. Co., 4011 Clark Ave., let contract building 2 story, 80 x 116 ft., rein.-con., steel and brick factory, at 3809 Clark Ave., to F. J. Kuka, 4216 Warner Rd., Lakewood. About $40,000.

★**O., Cleveland**—G. W. Worder Co., 6530 Carnegie Ave., let contract building 2 story, 47 x 120 ft., concrete, steel and brick addition to factory, to H. G. Slatmeyer Co., Lakeside Ave. About $25,000. Noted Aug. 21.

★**O., Dayton**—Dayton Pipe Coupling Co. let contract building 1 story, 90 x 120 ft. rein.-con. and steel forge and machine shop, rein.-con. flooring, concrete foundation, on Edmund St. to J. Lowes, Schwind Bldg. About $50,000.

★**O., Kent**—Mason Tire & Rubber Co. let contract building 2 story, 80 x 120 ft., rein.-con., steel and brick addition to factory, on Erie St., to Cummins Blair Co., Leader News Bldg., Cleveland. About $60,000. Noted July 24.

★**O., Urbana**—Urbana Packing Co. let contract building 2 story, 30 x 75 ft. power house and 2 story, 30 x 60 ft. storage plant, rein.-con. and brick, rein.-con. flooring, concrete foundation, to J. A. Poss, Springfield. About $30,000.

★**Ind., Ft. Wayne**—Thieme Bros. Co., Park Ave., let contract building rein.-con. and steel factory, rein.-con. floorings, concrete foundation on Rynnion and Morrison Aves., to Indiana Eng. & Constr. Co., 528 Lincoln Life Bldg. About $185,000.

★**Mich., Detroit**—A. Kahn, archt., Marquette Bldg., let contract to Bryan & Detwiler, Dime Bank Bldg., for 1 story, 241 x 446 ft. addition and 3 story, 80 x 225 ft. extension to factory, rein.-con. and steel, in West Grand Blvd. and Belt Line Ry., for Packard Motor Car Co., West Grand Blvd. Noted July 3.

Industrial Works (Continued)

★**Mich., Detroit**—Young Bros., Franklin St., let masonry contract building 1 and 2 story, 105 x 161 ft., concrete, brick and steel factory, rein.-con. flooring, concrete foundation on Beufait Ave., to Krieghoff Co., 1187 Bellevue Ave.; carpentry, to C. Reisdorf, 753 Greenwood Ave. Noted Aug. 28.

★**Ill., Chicago**—Knight Light & Soda Fountain Co., 351 West Chicago Ave., let contract building 3 story, 77 x 210 ft. and 1 story, 160 x 200 ft. mill construction factory, concrete foundation, on Kildare and Schubert Aves., to W. F. Peterson, 127 North Dearborn St. About $200,000.

★**Ill., Moline**—Moline Iron Wks. let contract building 1 story, 110 x 360 ft. and 110 x 400 ft. fireproof factories, to P. H. Lorenz, 413 Peoples Bank Bldg. About $200,000.

★**Wis., Chilton**—Aluminum Specialty Co., 17th and Wollmer Sts., let contract building 2 story, 60 x 200 ft. brick, and steel factory, rein.-con. flooring, brick foundation, on Main St., to Blake Constr. Co., Appleton, $71,020. Noted Sept. 4.

★**Wis., Milwaukee**—Edmonds Realty Co., let contract building 1 story 135 x 475 ft. brick and steel factory, concrete foundation, to H. J. Kusel, 35 South Dearborn St., Chicago. About $275,000.

★**Kan., Emporia**—McCord & Kistler Mercantile Co., 201 Kansas Ave., let contract building 2 story, 75 x 150 ft., rein.-con., steel and brick warehouse, rein.-con. flooring, rock and concrete foundation, to J. M. Leeper, State House, Topeka. About $71,000. Noted Aug. 28.

★**Neb., Omaha**—Item Biscuit Co., 202 Capitol Ave., let contract building 7 story, 118 x 132 ft., rein.-con., brick and steel addition to factory, rein.-con. flooring, concrete foundation, to C. F. Haglin & Son, 2706 10th Ave., Minneapolis, Minn. About $200,000.

★**Mo., St. Louis**—Landis Machine Co., 1515 North 25th St., let contract building 4 story, concrete and brick factory on 2nd and Gano Sts., to J. H. Bright Bldg. Co., Title Guarantee Bldg., $245,000.

★**Okla., Oklahoma**—Mideke Supply Co., 200 West 1st St., let contract constructing 1 story, 75 x 140 ft. warehouse and 3 story, 80 x 140 ft. main building, rein.-con. and brick, rein.-con. flooring concrete foundation, at 200 East Main St., to Reinhart & Donovan. Insurance Bldg., cost plus percentage basis.

★**Ore., Portland**—Royal Bakery Co., 441 Everett St., let contract building 1 story, 70 x 90 ft. and 2 story, 16 x 44 ft additions to bakery, brick and concrete, concrete foundation, on Vancouver Ave and Ivy St., to R. O. Powers, 214 Ry. Exch. Bldg. About $50,000.

★**Cal., Los Angeles**—Standard Oil Co., 1727 North Spring St., let contract building 1 story, 30 x 284 ft. garage and 80 x 198 ft. machine shop, concrete, concrete foundation, at 1726 North Spring St., to E. F. Low, 343 Wilcox Bldg., $63,000.

★**Cal., San Francisco**—Simmons Co., 198 Bay St., let contract building 135 x 278 ft. brick and timber factory, on Bay and Stockton Sts., to F. B. Peake, 1247 2nd Ave. About $100,000. Noted Sept. 11.

★**Que., Montreal**—W. C. M. Rees, Ontario St., let contract building 4 story, 50 x 75 ft. steel and brick factory, concrete foundation, to Atlas Co., 37 Belmont St. About $70,000.

★**Ont., Port Arthur**—Canadian Natl Rys., 27 Wellington St., E., Toronto, let contract building rein.-con. grain elevator, 700,000 bu. capacity, here, rein.-con. flooring rock and concrete foundation to Barnett & McQueen, Port Arthur. About $600,000, cost plus 10% basis.

Buildings

PROPOSED WORK

Mass., Amherst—Dormitory, etc.—Massachusetts Agricultural College having plans prepared by J. H. Ritchie, archt., 8 Beacon St., Boston, for 3 story, 60 x 155 ft., brick, steel and concrete dormitory and dining room, concrete foundation, on campus About $150,000. Noted May 15.

Mass., Framingham—School—Town having plans prepared by C. M. Baker, archt., 70 Equitable Bldg., Boston, for 2½ story, 16 room, brick, concrete and steel, on Hollis St. About $170,000. E. E. Bowers, clk. Noted May 22.

Mass., Framingham—School—Town having plans prepared by Kilham & Hopkins, archts., 9 Park St., Boston, for 2 story, 16 room, brick and steel, on Lincoln St. About $160,000. E. E. Bowers, clk.

Mass., Springfield—Home and Lodge—Knights of Columbus, 292 Worthington St., plans to build, brick, on Elm St. About $150,000. Architect not selected.

Mass., Worcester—Sales—See "Industrial Works."

R. I., Providence—Theatre and Business—S. Bomes, 71 Farragut Ave., having plans prepared by T. J. H. Pierce, archt., 230 Industrial Trust Bldg., for 1 and 2 story, 100 x 114 ft., brick and terra cotta, rein.-con. flooring, concrete foundation, on Broad and Gallatin Sts. About $50,000.

R. I., Woonsocket—Church—St. Michaels Greek Church, Blackstone St., having plans prepared by W. F. Fontaine, archt., Federal Bldg., for 1 story, brick. About $50,000.

Conn., Bridgeport—Church—L. A. Walsh, engr., 51 Leavenworth St., Waterbury, rejected bids building 50 x 130 ft., brick and steel, on Park Ave., for St. George Lithuanian congregation, Park Ave. and Johnson St. About $50,000. Project postponed until next spring. Noted Aug. 14.

Conn., Bridgeport—Theatre and Business—S. Z. Poli, 24 Church St., New Haven, plans to build brick, concrete and steel, on Main, Congress and Arch Sts., here. About $1,000,000. T. W. Lamb, 644-8th Ave., New York City, archt.

Conn., Bristol—School—City plans to build brick and steel, on Burlington Ave. About $125,000. Architect not selected.

Conn., Meriden—Cottages — Connecticut School for Boys having plans prepared by Ford, Buck & Sheldon, Inc., engrs., 60 Prospect St., Hartford, for 2 dormitory cottages. About $82,000.

Conn., Orange—School—Town plans to build 2 story, 8 room, brick and steel, school, on 1st Ave. and Lamson St. About $100,000. J. A. McLaughlin, 241 Spring St., West Haven, chn. Architect not selected.

Conn., South Manchester—Business—J. Mamacos, 785 Main St., plans to build 3 story brick and steel, on Main St. About $70,000. A. E. Fiske, 67 Bigelow St., archt.

Conn., Trumbull—Schools—Town having plans prepared by F. A. Cooper, archt., 1024 Main St., Bridgeport, for school, in Long Hill Dist and 2 story school in Nichols Dist., both brick. About $50,000 each. H. F. Randall, selectman. Noted Aug. 14.

Conn., Vernon—School—Town plans to remodel high school on School St. About $35,000. Architect not selected.

N. Y., Buffalo — Theatre — Famous Players-Lasky Corp., 485 5th Ave., New York City, plans to build brick, steel and stone, brick foundation, here. About $600,000. De Rosa & Pereira, 110 West 40th St., New York City, archts. and engrs.

N. Y., Lockport—Bank—P. A. Davis, archt., 1713 Sansom St., Phila., soon receives bids building 1 story, 50 x 60 ft. steel and stone, for Natl. Exch. Bank, 45 Main St. About $150,000. Noted July 17.

N. Y., New York—School—Bd. Educ. having plans prepared by C. B. J. Snyder, archt. and engr., Municipal Bldg., for 4 story, 92 x 194 ft. brick and steel, brick foundation on Bathgate Ave. and 182nd St. About $420,000.

N. Y., New York—Theatre and Office—Famous Players—Lasky Corp., 485 5th Ave., plans to build 200 x 207 ft. brick, steel and stone, brick foundation, on Bway. between 43rd and 44th Sts. About $3,000,000. Architect or engineer not selected

N. J., Asbury Park—Theatre—T. W. Lamb, archt., 644 8th Ave., New York City, receives bids about Sept. 23, for alterations to brick, steel and stone, on Cookman Ave. and St. James Pl., for W. Rosenberg. About $100,000.

N. J., East Paterson—School—A. W. Gall, dist. clk. bd. educ., receives bids about November, building 8 room school in Dundee Lake Sect. About $75,000. Noted Sept. 12, 1918.

N. J., Trenton—Hotel—Stacy-Trent Co., Broad St. Bank Bldg., rejected bids received Sept. 3, building 10 story, rein.-con., brick and steel on West State St. About $1,000,000. Work will be readvertised. Noted Aug. 14.

N. J., Trenton—Theatre—W. J. Vernon, St. Regis Bldg., plans to build 2 story, 100 x 175 ft., brick and steel, on South Broad St. About $150,000. W. W. Slack & Son, St. Regis Bldg., archt.

Pa., Phila.—Bank—J. T. Brugger, archt., 505 Chestnut St., soon lets contract building 3 story, 60 x 75 ft., concrete and stone, on 3rd and Arch Sts., for Union Natl. Bank. About $100,000. Noted July 17.

Pa., Phila.—Store and Office—Marcus Felt Realty Co., 1303 Market St., plans to build 20 story, 75 x 150 ft. brick, steel and terra cotta, on Market and 13th Sts. About $2,500,000. Graham, Anderson, Probst & White, Ry. Exch. Bldg., Chicago, archts.

Pa., Phila.—Theatre—W. H. Lee, archt., 32 South 17th St., soon receives bids building 2 story, 75 x 120 ft. concrete and brick, on 5th and Rockland Sts., for Green & Altman, 2132 Germantown Ave. Cost to exceed $50,000.

Md., Baltimore—Office—G. Ober & Sons Co., U. S. Fidelity & Guaranty Co. Bldg., plans to build 3 story, 30 x 60 ft., brick and stone, stone and concrete foundation, on Lombard and Grant Sts. About $50,000. Parker, Thomas & Rice, 1109 Union Trust Bldg., archts

Md., Baltimore — Sales — Backus Motor Co., 10-20 East North Ave., plans to build 2 story, 100 x 200 ft., brick addition. About $50,000. E. T. Backus, pres.

Md., Baltimore—Sales—I. Silberstein, 607 Equitable Bldg., plans to build 10 story, 140 x 181 ft., rein.-con., steel and brick, rein.-con. flooring, concrete foundation, on St. Paul and Pleasant Sts. About $1,000,000. G. R. Callis, Jr., Mellville Ave., Catonsville, archt.

Md., Baltimore—Synagogue—Har Zion congregation plans to build synagogue on West North Ave. near Payson St., probably stone with stone foundation. About $75,000. L. Setten, 4195 Hanover St., and S. B. Waxman, 2410 Elsinor Ave., members bldg. com. Architect not selected.

N. C., Hendersonville—Hotel—J. O. Bell and others plan to build hotel. About $100,000. Architect not selected.

Fla., Miami—Depot—Florida East Coast Ry., 10th St., plans to build 40 x 60 ft. depot, here. About $75,000. E. B. Carter, St. Augustine, ch. engr.

Fla., St. Augustine—Auditorium—See "Sewers".

O., Akron—Church—St. Paul's Evangelical congregation having plans prepared by R. H. Hinsdale, archt., Bangor Bldg., Cleveland, for 1 story, steel, stone and brick. About $75,000.

O., Cleveland—Bank—Natl. City Bank, Leader-News Bldg., having plans prepared by Graham, Anderson, Probst & White, engrs., Ry. Exch. Bldg., Chicago, altering 10 story, concrete, steel and brick, on East 6th St. and Euclid Ave. About $75,000.

O., Cleveland—Club and Office—Cleveland Athletic Club, Euclid Ave., plans to build 11 story, 150 x 250 ft., rein.-con. steel, limestone and brick, on Superior Ave. About $500,000. Architect not selected.

O., Cleveland—Commercial—Greenlawn Realty Co., Society for Savings Bldg., plans to build 8 story, 100 x 200 ft., rein.-con., steel and brick, at 3208 Prospect Ave. About $500,000. Architect not selected.

O., Cleveland—Commercial—G. W. Hale, Leader News Bldg., plans to build 6 story, 95 x 300 ft., rein.-con., steel and brick, on East 9th St. and Prospect Ave. About $125,000. Architect not selected.

O., Cleveland — Commercial — Hampton Keller Co., Swetland Bldg., plans to build 9 story, 100 x 100 ft., rein.-con., steel and brick, at 10017 Euclid Ave. About $125,000. Architect not selected.

O., Cleveland—Commercial—Hinning Furniture Co., St. Clair Ave., plans to build 3 story, 79 x 84 ft., rein.-con., steel and brick About $75,000. Architect not selected.

O., Cleveland—Commercial—L. W. Kelley, Hickox Bldg., plans to build 10 story, 148 x 220 ft., rein.-con., steel, terra cotta and brick, at 2425 Euclid Ave. About $300,000. Architect not selected.

O., Cleveland—Commercial—E. D. Latimer, 12037 Lake Ave., plans to build 7 story, 120 x 200 ft., rein.-con., steel and brick, on East 50th St. and Prospect Ave. About $200,000. Architect not selected.

O., Cleveland—Commercial—F. C. Newcomer, Citizens Bldg., plans to build 6 story, 100 x 125 ft., rein.-con., steel and brick, on 86th St. and Euclid Ave. About $100,000. Architect not selected.

O., Cleveland — Commercial — Petrequin Paper Co., West 3rd St., plans to build 4 story, 120 x 200 ft., rein.-con., steel and brick, on East 48th St. and Prospect Ave. About $120,000. Architect not selected.

Buildings. (Continued)

O., Cleveland — Commercial — Prame Realty Co., Williamson Bldg., plans to build 8 story, 100 x 200 ft., rein.-con., steel and brick, on Prospect Ave. About $500,000. Architect not selected.

O., Cleveland — Hospital — Huron Rd. Hospital Assn., Huron Rd., plans to build 5 story, 150 x 190 ft., rein.-con., steel and brick, on Ans 1 Rd. About $500,000. Architect not selected.

O., Cleveland—Hospital—Lakeside Hospital Assn., East 12th St. and Lakeside Ave., plans to build 12 story, 200 x 350 ft., rein.-con., steel and brick, on University Circle. About $2,000,000. Architect not selected.

O., Cleveland—Hotel—L. W. Kelley, Hickox Bldg., plans to build 6 story, 80 x 200 ft., rein.-con., steel and brick, on Euclid Ave. About $100,000. Architect not selected.

O., Cleveland—Loft—Paudett Investment Co., Citizens Bldg., plans to build 6 story, x 122 ft., rein.-con., steel and brick, at 1825 East 18th St. About $125,000. Architect not selected.

O., Cleveland—Office—Altamont Realty Co., Williamson Bldg., plans to build 6 story, 99 x 125 ft., rein.-con., steel, terra cotta and brick, at 1730 East 12th St. About $250,000. Architect not selected.

O., Cleveland — Office—See "Industrial Works."

O., Cleveland—Office—A. L. Newman, 647 Euclid Ave., plans to build 1 story, 70 x 100 ft., rein.-con., steel and brick addition, at 1126 Euclid Ave. About $60,000. Architect not selected.

O., Cleveland—Office—Willard Storage Battery Co., 246 East 131st St., having plans prepared by H. H. Aldrich, archt., c/o owner, for 2 story, 50 x 104 ft., rein.-con., steel and brick addition. About $60,000.

O., Cleveland—Sales Room—See "Industrial Works."

O., Cleveland—Sales—Kelley Springfield Tire Co., Prospect Ave., leased 90 x 200 ft. site on East 46th St. and Prospect Ave., and plans to build 5 story, rein.-con., steel and brick. About $100,000. Architect not selected.

O., Cleveland—Studio—J. N. Ackerman, Engineer's Bldg., plans to build 1 story, 100 x 500 ft., rein.-con., steel and brick, on West 25th St. About $500,000. Architect not selected.

O., Cleveland Heights (Warrensville P. O.)—Theatre—Israel & Makoff, 3533 Woodland Ave., plans to build 6 story, 100 x 150 ft., rein.-con., steel and brick, on Euclid Blvd. About $175,000. Architect not selected.

O., Massillon — Commercial—Bloomberg Clothing Co. having plans prepared by Albrecht, Wilhelm & Kelley, archts., 1836 Euclid Ave., Cleveland, for 3 story, 46 x 167 ft., rein.-con., steel and brick, on East Main St. About $75,000.

O., Mount Vernon—Office—See "Industrial Works."

O., Norwalk—Bank and Office—Citizens Natl. Bank plans to raze present structure and build 5 story, 50 x 115 ft., rein.-con., brick and stone, concrete foundation. About $175,000. Mills & Millspaugh, 67 East Long St., Columbus, archts.

O., Richwood—Church—Baptist Church Society plans to build 64 x 82 ft., rein-con. and brick, concrete foundation. About $50,000, cost plus percentage basis. E. E. Pruitty Comstock Bldg., Columbus, archt.

O., Wilmington—Bank—First Natl. Bank plans to construct modern banking building. About $85,000.

Ind., Indianapolis—Theatre and Office—Loew's Enterprises, 1492 Bway., New York City, having preliminary plans prepared by T. W. Lamb, archt., 644 8th Ave., New York City, building 2 story, 100 x 175 ft., brick, steel and stone, brick foundation, here. About $300,000.

Mich., Bay City—Office and Store Room —See "Industrial Works."

Mich., Detroit—Schools—Bd. Educ. soon lets contracts building Angell School, 2 story, 83 x 93 ft., rein.-con., brick and steel rein.-con. flooring, concrete foundation on Holmer Ave., between Maidstone and Euclid Aves.; Trowbridge School 2 story, 58 x 112 ft., rein.-con., brick and steel, rein.-con.-flooring, concrete foundation on Forest Ave. near St. Antoine St., cost, $200,000; Carstens School, 2 story, 44 x 168 ft., rein.-con., brick and steel, rein.-con. flooring, concrete foundation, on Coplin Ave. near Charlevoix Ave.; Davison Annex, 2 story, 80 x 80 ft. frame, concrete foundation, on Davison and Joseph Campau Aves. $25,000; Clippert School, 1 and 2 story, 34 x 102 ft., frame, concrete foundation, on Martin St. near Michigan Ave., $25,000. Malcolmson & Higginbotham, 404 Moffat Bldg., archts.

Ill., Chicago — Office — Reliance State Bank, 1551 West Madison St., having plans prepared by Weary & Alford, archts., 1732 South Michigan Ave., for altering 1st floor of 50 x 165 ft. building, on Ogden Ave and Madison St. About $100,000.

Ill., Chicago—Offices — See "Industrial Works."

Ill., Chicago—Club—E. P. Rupert, archt., 154 West Randolph St., soon receives bids building 4 story, 60 x 120 ft., on south side, for B. P. O. Elks, c/o architect. About $125,000.

Ill., Joliet—Synagogue—D. S. Klafter, archt., 64 West Randolph St., Chicago, soon receives bids building 1 story, 60 x 100 ft. brick and timber, concrete foundation, on Lincoln St., for Bnai Jacob congregation. About $100,000.

Wis., Holy Hill (Hartford)—Monastery—Carmelite Brothers having plans prepared by Brust & Philipp, archts. and engrs., Free Press Bldg., Milwaukee, for 3 story, 60 x 210 ft. brick, steel, rein.-con. and tile, brick foundation. About $60,000.

Wis., Marshfield — Bank — First Natl. Bank plans to build 2 story, 50 x 100 ft. brick and stone. About $100,000. Architect not selected.

Wis., Thorpe—School—Bd. Educ. having plans prepared by W. L. Alban, archt., 347 Endicott Bldg., St. Paul, Minn., for 2 story, 63 x 82 ft. About $50,000.

Ia., Creston—School—Bd. Educ. having plans prepared by W. Gordon, archt., Hubbell Bldg., Des Moines, for 2 story, 52 x 81 ft., concrete, steel and brick, concrete foundation. About $50,000.

Ia., Davenport—Temple—Masonic Lodge plans to build 8 story, 150 x 200 ft., on 7th and Main Sts. About $800,000. Clausen & Kruse, 316 Central Office Bldg., archts.

Ia., Glidden—School—Bd. Educ. having plans prepared by W. Gordon, archt., 319 Hubbell Bldg., Des Moines, for 2 story, 52 x 81 ft. concrete, steel and brick, concrete foundation. About $50,000.

Ia., Spencer—School—Bd. Educ. Lake Twp. having plans prepared by W. Gordon, archt., 319 Hubbell Bldg., Des Moines, for 2 story, concrete, steel and brick. About $50,000.

Kan., Atchison—School—Bd. Educ. having plans prepared by W. H. Saylor & Co., Kansas City, Mo., for 3 story, 78 x 121 ft., rein.-con., steel and brick, rein.-con. flooring, concrete foundation, to be known as Roosevelt School. About $75,000.

Kan., Caney—Church—First Methodist Episcopal Church having plans prepared by F. F. Fletcher, archt., Independence, Mo., building 1 story concrete, steel and brick, concrete foundation. About $55,000.

Kan., Lyndon—Court House—Osage Co. rejected bids received Sept. 4, building 3 story, 84 x 100 ft. rein.-con., steel and brick, rein.-con. flooring, rock and concrete foundation. Work will be readvertised. W. E. Hulse & Co., Hutchinson, archts. Noted Aug. 21.

N. D., Grand Forks—Hotel—F. Parsons, 825 Belmont Ave., L. J. Bemis and E. J. Stuart, plan to build hotel here. About $500,000.

Mont., Deer Lodge—Court House—Powell Co. voted $10,000 bonds to build court house. H. B. Hertz, Jr., co. clk. Architect not selected. Noted June 26.

Mo., Rockport—Memorial—Atchison Co. having revised plans prepared and soon receives bids building 2 story, 68 x 110 ft., rein.-con., steel and brick, concrete foundation, here. About $60,000. J. O. Hogg, New York Life Bldg., Kansas City, archt.

Mo., St. Louis—Church—Labadie Presbyterian congregation acquired 80 x 150 ft. site on Labadia Ave. and plans to build rock and brick church. About $60,000. Architect not selected.

Mo., St. Louis—High School—Blessed Sacrament congregation plans to build high school. About $75,000 available for project. P. H. Bradley, King's Highway and Northland Ave., pastor. Architect not selected.

Mo., St. Louis—Hotel—C. Levy Realty & Bldg. Co., c/o C. Levy, Hub Furniture Co., 9th and Washington Sts., plans to build 12 story concrete, steel and brick, to be known as Hotel Claridge. About $1,000,000. Architect to be announced later.

Tex., San Angelo—Hotel—J. W. White, Mason, plans to build 8 story hotel, on Chadbourne and Concho Sts., here. About $300,000.

Tex., San Antonio — Home — Salvation Army, 805 Ave. D., plans to build rescue home, brick. About $100,000.

Okla., Ardmore—Post—Salvation Army plans to construct army post building on Main St. About $50,000.

HIGHWAY—ARIZONA

Bids were received by State Highway Department, Phoenix, (lowest 3) for constructing Tempe-Mesa Highway, Federal Aid Project No 8, from (A) McElrath & Shumway, Mesa; (B) G. R. Curtis, 2440 East 26th St., Los Angeles, Cal.; (C) Southwestern Contg. Co., 13th and Lincoln Aves. The unit bids were as follows:

	A	B	C
1,654 cu.yd. excavation (unclassified)	$2.00	$0.90	$2.00
15,936 sq.yd. concrete pavement	1.54	1.65	1.56 a=$24,860.16
15,936 sq.yd. bitulithic pavement on concrete base			
Informal { 5-in. concrete base—2-in. bitulithic top)			1.95 b= 34,705.70
Informal { 4-in. concrete base—2-in. bitulithic top)			1.85 c= 33,112.10
15,936 sq.yd. bitulithic pavement on asphaltic concrete base			
20 cu.yd. Class "A" concrete (headwalls, etc.)	17.00	12.00	15.00
750 lb. reinforcing steel	.03	.05	.03
Cost of cement and reinforcing steel (to be furnished by State)			a=$13,043.25—Concrete b= 7,012.15—5-2 c= 5,628.50—4-2
Totals—Informal			a=$41,533.91—Concrete b= 45,397.10—5-2 c= 42,419.95—4-2
18,750 cu.yd. excavation (unclassified)	1.00	.90	.98
990 cu.yd. caliche (for shoulders)	2.00	1.00	2.40
58,744 sq.yd. concrete pavement	1.54	1.65	1.56 a=$91,640.64
58,744 sq.yd. bitulithic pavement on concrete base			
Informal { 5-in. concrete base—2-in. bitulithic top)			2.22 b=130,411.68
Informal { 4-in. concrete base—2-in. bitulithic top)			2.12 c=124,537.28
58,744 sq.yd. bitulithic pavement on asphaltic concrete base			
238 lin.ft. 18-in. concrete pipe culvert, standard sec. "B"	1.30	2.00	2.88
52 lin.ft. 24-in. concrete pipe culvert, standard Sec. "B"	2.00	3.00	5.04
169 lin.ft. 30-in. concrete pipe culvert, standard Sec. "B"	3.40	3.60	6.78
114 lin.ft., 36-in. concrete pipe culvert, standard Sec. "B"	4.00	4.00	8.16
16 lin. ft. 48-in. concrete pipe culvert, standard Sec. "B"	4.50	5.00	10.00
55 lin.ft. 24-in. corrugated metal pipe culvert (R.R. crossing)	6.00	3.00	5.04
127 cu.yd. Class "A" concrete (headwalls, etc.)	17.00	12.00	20.00
Cost of cement (to be furnished by State)			a=$47,556.95—Concrete b= 26,567.70—5-2 c= 21,467.15—4-2
Extended totals	$162,757	$165,815	a=$165,949.37—Concrete b= 183,731.16—5-2 c= 172,756.21—4-2

Buildings (Continued)

Okla., Bristow—Church and Parsonage—Christain congregation has acquired site on 6th St. and plans to build church and parsonage. About $120,000. R. V. Vesey, pastor.

Okla., Cherokee—School—Bd. Educ. having plans prepared by Mann & Gerow, archts., Hutchinson, Kan., building 2 story concrete, steel and brick, concrete foundation. About $60,000.

Okla., Muskogee—High School—Bd. of Educ. having plans prepared by H. O. Valeur & Co., archts., 705 Phoenix Bldg., building 3 story, 100 x 120 ft., rein.-con., steel and brick Junior High School, rein.-con. flooring, concrete foundation. About $230,000.

Okla., Oklahoma—High Schools—City had plans prepared by Layton, Smith & Forsyth, archts. and engrs., 701 Major Bldg., for one 3 story and two 2 story, 140 x 358 ft., brick and stone high schools. About $165,000 each.

Okla., Oklahoma—Home—Elks plan to build new home. About $125,000. Architect not selected.

Okla., Tecumseh—School—State Bd. Pub. Affairs, Oklahoma, plans to build industrial school here for girls. About $185,000. Architect not selected.

Okla., Tulsa—High School—Bd. Educ. having plans prepared by G. Winkler, archt., 414 Palace Bldg., 3 story, 125 x 260 ft., rein.-con., steel and brick, rein.-con. flooring, rock foundation. About $350,000. Hedrick & Huff, Kansas City, Mo., engrs.

Idaho, Boise—Capitol—State Comn. Pub. Wks. soon lets contract building east and west wings to Capitol, 2 story, cut stone. About $900,000 available. Tourtellotte & Hummel, 215 Overland Bldg., archts.

Idaho, Lewistown—Business—J. A. Johnson plans to build 3 story, 76 x 20 ft., brick, brick and concrete foundation, on Main St. About $135,000. Architect not selected.

Idaho, Nampa—Dormitory and Sanitorium—Nazarene College plans to build 2 or 3 story brick. About $50,000. Architect not selected.

Ariz., Phoenix — Hotel — J. W. Walker having plans prepared by L. M. Fitzhugh, archt., 210 Noll Bldg., for 4 story, 56 x 138 ft., rein.-con.

Wash., Chehalis—Store—L. Proffitt plans to build 2 or 3 story, 40 x 58 ft., brick, brick foundation, on Chehalis Ave. About $50,000. Architect not selected.

Wash., Seattle—School—Bd. Educ. plans to build 2 story, 42 x 162 ft., concrete and brick addition to Greenwood School, on 3rd Ave. N. W. and 80th St. About $125,000. F. A. Naramore, care of School Bd., archt.

Wash., Toppenish — Church — Methodist congregation having plans prepared by J. Vogel, archt., Seattle, for 2 story, brick or stone, concrete foundation, to include gymnasium, etc. About $50,000.

Wash., Yakima—Theatre—J. C. Von Herberg and associates, Seattle, plan to build 1 story, concrete or stone, here. About $200,000. Archt. to be announced later.

Ore., Baker — Mercantile — Basche-Sage Hardware Co. having plans prepared by H. W. Bond, archt., Baker, for 2 story, 100 x 200 ft. brick or concrete, concrete foundation, on Main and Center Sts. About $125,000.

Ore., Condon—School—School Dist. No. 25 having preliminary plans prepared for 2 story brick or stone. Special election soon to vote on $55,000 bonds for project.

Ore., Freewater—Bank—First Natl. Bank plans to build 1 story, 50 x 70 ft., brick and terra cotta. About $50,000. P. T. Ainge, Freewater, designer.

Ore., Portland—Natatorium—J. M. Rieg Gerlinger Bldg., plans to build 1 story brick or concrete, concrete foundation, on Columbia Beach, to include 75 x 150 ft. tank, 1000 lockers, convertible floors auditorium, glass sun room, etc. About $55,000. Private plans.

Ore., Portland—Office—M. Pallay, Garden Home, plans to build 2 or 3 story, 100 x 120 ft. brick or concrete, on 15th and Alder Sts. About $50,000. Archt. not selected.

Cal., Bakersfield—Store—Conklin-Brodek Estate, care of O. Clark, archt., Bakersfield, having plans prepared for 3 story, 115 x 132 ft., rein-con., brick and terra cotta, rein.-con. flooring, concrete foundation, on 20th and Chester Sts. About $100,000. Hochheimer & Co., lessee.

Cal., Fullerton—Lodge—Masonic Temple Assn. having plans prepared by F. Benchley, archt., Fullerton, for brick, on Sondra and Chapman Aves. About $60,000. Noted Aug. 14.

Cal., Los Angeles—Sales—J. A. Graves, care of Morgan Walls & Morgan, archts., 1124 Van Nuys Bldg., plans to build 2 story, 100 x 150 ft., rein.-con., rein.-con. flooring, concrete foundation, on Figueroa St. Maxwell-Hoffman Co., 10th St. and Grand Ave., lessee.

Cal., Pasadena—Administration—See "Industrial Work."

Cal., San Francisco—Store and Loft—Rousseau & Rousseau, archts., 110 Sutter St., soon receive bids building 2 story, 60 x 135 ft., brick, concrete foundation, on Sutter St., for Dunn, Williams & Co., Crocker Bldg. About $65,000. E. Curtiss, 314 Sutter St., lessee.

Que., Granby—Hospice—Sisters of Congregation of Grey Nuns, Marieville, having plans prepared and soon receive bids building 3 story, 40 x 100 ft., on Notre Dame St. here. About $62,000. Private plans.

Ont., Windsor—School—Bd. Educ. La Belle Bldg., receives bids about Sept. 24, building 3 story, 215 x 230 ft. rein.-con. and brick, rein.-con. flooring, concrete foundation, on Giles Blvd. About $200,000. A. H. McPhail, Bd. Trade Bldg., archt. Noted July 10.

BIDS DESIRED

Mass., Belchertown — Dormitory — Until Sept. 29, by Massachusetts Comn. on Mental Diseases, Boston, building 2 story, 64 x 89 ft. dormitory and 3 story, 88 x 103 ft. power house, rein.-con. and terra cotta, rein.-con. flooring, concrete foundation, on State grounds, also 1325 ft. concrete tunnels, for Massachusetts State Hospital, here. Noted Feb. 6.

Mass., Worcester—School—Until Sept. 23, by Trustees of Independent Industrial Schools, c/o Frost & Chamberlain, archts., 390 Main St., building trade school for girls, on High St., 3 story, 90 x 145 ft., brick, concrete foundation. About $175,000. Noted Aug. 28.

Conn., Bridgeport—Police Station—Until Sept. 22, by Bd. Police Comrs., building station and garage, on Barnum Ave. and Caroline St., 2 story, 55 x 75 ft. brick, steel and concrete, rein.-con. flooring, concrete foundation. About $60,000. W. J. Skinner, 1188 Main St., archt. Noted July 24.

Conn., Manchester—Fire Station—Until Sept. 20, by town, building 2 story, brick, concrete and steel, rein.-con. flooring, concrete foundation, on Main and Hilliard Sts. About $50,000. A. E. Fiske, 67 Bigelow St., archt. Noted June 26.

Conn., Redding—Museum—Until Sept. 25, by Sunderland & Watson, archts., 248 Main St., Danbury, for 1 story brick and concrete building, rein.-con. flooring, concrete foundation, on Putnam Park, for Israel Putnam Memorial Camp Ground Comn. About $50,000.

Conn., Willimantic — Dormitory — Until Sept. 22, by State Bd. Educ., and W. H. Brooks, archt., Lewis and Gold Sts., both of Hartford, building 3 story, 46 x 114 ft. with 30 x 46 ft. ell, brick, steel and concrete, rein.-con. flooring, concrete and brick foundation, on Valley St., for State Normal School, here. About $150,000. Noted July 24.

N. Y., New York—Theatre—Until Sept. 22, by De Rosa & Pereira, archts. and engrs., 110 West 40th St., building brick and steel, brick foundation, on 9th Ave. and 45th St., for Consolidated Amusement Enterprises, 2139 8th Ave. About $75,000. Noted Sept. 4.

Pa., Phila.—Bank—P. A. Davis, archt., 1713 Sansom St., receiving bids building 1 story, 37 x 65 ft., brick and marble, on Diamond and Broad Sts., for Broad St. Bank. Cost to exceed $50,000.

N. C., Brevard—Jail and Court House—Until Oct. 3, by C. K. Osborne, clk. Transylvania Co., building new 3 story, jail and addition to court house. About $150,000. T. E. Davis, Asheville, archt.

Ala., Bessemer—Exchange—Until Sept. 23, by Southern Bell Telephone & Telegraph Co., 78 South Pryor St., Atlanta, building 2 story, 50 x 50 ft., concrete, steel and stone, on 4th Ave. between 18th and 19th Sts., here. About $75,000.

O., Akron—School—J. R. Graham, archt., 422 Union Bldg., Cleveland, receiving bids building 1 story, 78 x 180 ft., rein.-con., steel, terra cotta and brick, on East Talmadge Ave., for St. Martha's. About $75,000.

O., Cleveland—Church—H. W. Maurer, archt., Schofield Bldg., receiving bids building 3 story, 38 x 95 ft., rein.-con., steel and brick, on Hayden Ave., for 9th United Church. About $50,000.

O., Cleveland—Library—Cleveland Pub. Library Assn., 1375 Euclid Ave., receiving bids building 8 story, 200 x 400 ft., rein.-con., steel, brick, stone and granite, on East 3rd St. and Superior Ave. About $1,000,000. Walker & Weeks, 1900 Euclid Ave., archts.

O., Cleveland—Observatory—Walker & Weeks, engrs., 1900 Euclid Ave., receiving bids building 3 story, 45 x 60 ft., rein.-con., steel and brick for Warner & Swasey Co., Taylor Rd. About $50,000.

O., Hudson—School—J. W. Corbusier, archt., Lenox Bldg., Cleveland, receiving bids building 2 story, 40 x 56 ft., brick and timber, on Elk St., for Hudson Congregational Church. About $50,000.

O., Independence—School—W. H. Nicklas, archt., 1900 Euclid Ave., Cleveland, receiving bids building 2 story, 90 x 140 ft., rein.-con., steel and brick, on Broadview Rd., for Bd. Educ. About $75,000.

O., Steubenville—Bank—Walker & Weeks, archts., 1900 Euclid Ave., Cleveland, receiving bids building 12 story, 56 x 90 ft. rein.-con., steel and brick, on 4th and Market Sts., for Steubenville Bank & Trust Co. About $75,000. Noted Aug. 14.

O., Tiffin — Bank — Walker & Weeks, archts., 1900 Euclid Ave., Cleveland, receiving bids building 2 story, 50 x 100 ft., rein.-con., steel, stone and brick, on Washington St., for Tiffin Natl. Bank. About $60,000. Noted Aug. 7.

Mich., Charlevoix—Jail—Until Sept. 25, by Bd. Supervs. Charlevoix Co., building 2 story, 38 x 62 ft., rein. con., brick and steel, concrete foundation. About $50,000. A. E. Munger, Bay City, archt.

Mich., Detroit—Administration—A. Kahn, archt., Marquette Bldg., receiving bids building 2 story, 60 x 100 ft., rein.-con. brick and steel, rein.-con. flooring, concrete foundation, on Wyoming and West Warren Aves., for Detroit Seamless Steel Tube Co., 841 Jefferson Ave., W. About $70,000.

Mich., Detroit—Home—A. Kahn, archt., Marquette Bldg., receiving bids building nurses home, 6 story, 115 x 154 ft., rein.-con., brick and stone, rein.-con. flooring, concrete foundation, at Harper Hospital, on John R St. About $350,000. Noted June 12.

Mich., Detroit—Office—A. Kahn, archt., Marquette Bldg., receiving bids for 1 and 2 story, 50 x 123 and 23 x 30 ft., rein.-con. and steel, rein.-con. flooring, concrete foundation, on Vancouver Ave., for Holley Carburetor Co., Vancouver Ave. About $50,000.

Wis., Clintonville—Bank—Until Sept. 27, by Foeller & Schober, archts., 123 North Washington St., Green Bay, building 2 story, 60 x 120 ft., brick, rein.-con. and steel, brick foundation, for 1st Natl. Bank. About $50,000.

Wis., Hartford—Hospital—Until Sept. 22, by Hartford General Hospital, building 3 story 38 x 150 ft. brick and rein.-con. rein.-con. flooring, brick foundation, on Main St. About $50,000. Private plans.

Ia., Ankeny—High School—Until Sept. 29, by Bd. Educ., building 2 story, 75 x 118 ft., rein.-con. and timber, rock and concrete foundation. About $60,000. W. Gordon, 319 Hubbell Bldg., Des Moines, archt.

Minn., Balaton—School—Until Sept. 22, by Bd. Educ., building 2 story, 64 x 86 ft., brick. About $75,000. J. W. Carlaw, clk. C. H. Parson, 600 Builders Exch., Minneapolis, archts. Noted Aug. 28.

Minn., Minneapolis—Hotel and Business—B. N. Schneider, 232 Plymouth Bldg., receiving bids building 6 story, 122 x 178 ft., concrete, hollow tile and brick, on Franklin and Colfax Sts. About $800,000. F. Van Antwerp, 240 La Salle Bldg., archt. and engr.

Kan., Wichita—Auditorium, Dormitory, etc.—Until Oct. 1, by Sisters of Charity, building 2 story, 47 x 90 ft. auditorium, 1 story 36 x 144 ft. dormitory and 2 story, 47 x 90 ft. chapel, rein.-con. and brick, rein.-con. flooring, concrete foundation. About $250,000. White & Dean, 301 Bellefontaine Ave., Kansas City, Mo., archts.

N. D., Ashley—Courthouse—Until Oct. 17, by J. Hildenbrand, aud. McIntosh Co., building 2 story, 56 x 75 ft., rein.-con. About $75,000. Buechner & Orth, 500 Shubert Bldg., St. Paul, Minn., archts.

Mo., Brookfield—School—Until Sept. 25, by Bd. Educ., building 2 story, rein.-con., steel and brick rein.-con. flooring, rock foundation. About $80,000. M. S. Martin, Hannibal, archt.

Buildings (Continued)

Mo., St. Joseph—Sunday School—First Presbyterian congregation receiving bids building 3 story, 42 x 55 ft., rein.-con., steel and brick, rein.-con. flooring, concrete and rock foundation, on 7th and Faron Sts. About $60,000. Echel & Aldrich, Corby Bldg., archts. Noted Aug. 7.

Okla., Cherokee—High School—Until Oct. 10, by Comrs. Alfalfa Co., building 3 story, 69 x 140 ft., on Main St. About $60,000. Mann & Gerow, Hutchinson, Kan., archts. and engrs.

Ont., Windsor—Mercantile—A. H. McPhail, archt., Bd. Trade Bldgs., receiving bids building 6 story 30 x 120 ft., rein.-con., brick and steel, rein.-con. flooring, concrete foundation, on Ouelette Ave. for C. H. Smith Co., Pitt St. About $100,000.

PRCIES AND CONTRACTS AWARDED

(★Indicates award of contract)

★**Conn., Waterbury**—Bank and Office—Morris Plan Co., 68 Center St., let contract building 3 story, brick and concrete, rein.-con. flooring, concrete foundation, on Grand St., to Tracy Bros. Co., 52 Benedict St. About $50,000. Noted Sept. 11.

★**Conn., West Hartford** (Hartford P. O.)—Hotel—Sleeper & Parisi, 26 State St., Hartford, will build two 6 story, 70 x 180 ft., brick, steel and concrete, rein.-con. flooring, concrete foundation, on Whiting Lane and Arnoldale Rd. About $325,000. Work will be done by day labor.

N. Y., Kings Park—Hospital—State Hospital Comn., Capitol, Albany, received bids Sept. 10, building hospital for acute patients, at Kings Park State Hospital here, (general contract) from M. Kantrowitz, 20½ Market St., Albany, $277,700, P. J. Carlin Constr. Co., 1123 Bway., New York City, $330,000, W. Moore & Co., 347 Madison Ave., New York City, $357,646; heating, from A. B. Barr & Co., 6 River St., Yonkers, $21,800, Adams-Britz & Co., Inc., 1769 Park Ave., New York City, $21,900. E. Rutzler Co., 404 East 49th St., New York City, $22,327; plumbing, from W. B. Armstrong Co., 3 Fulton St., Albany, $31,600, C. H. Darmstadt, 352 West 43rd St., New York City, $31,942, T. E. O'Brien, 6311-5th Ave., Brooklyn, $37,447. Noted Aug. 28.

★**N. Y., New York**—Clubhouse—Chinese Merchants Assn, c/o W. Rahmans Sons, archts. and engrs., 126 Cedar St., will build 6 story, 25 x 84 ft. brick, steel and stone, brick foundation, at 41 Mott St. About $70,000. Work will be done by day labor under supervision of architects.

N. Y., Troy—Armory—W. W. Ward, secy. state bd. armory comrs., 158 State St., Albany, received bids Sept. 4 furnishing labor and materials for building state armory here, from C. Crowley Co., 114 3rd St., $339,400; P. Keeler Bldg. Co., 425 Orange St., Albany, $379,140; M. Kantrowitz, 20½ Market St., Albany, $367,800. Noted Aug. 21.

★**Md., Baltimore**—Dormitory and Swimming Pool—St. Mary's Industrial School, Wilkens and Caton Aves., let contract building 4 story, 63 x 131 ft., rein.-con., stone and brick dormitory, stone and concrete foundation, and 30 x 75 ft., concrete swimming pool, to Price Constr. Co., 210 Maryland Trust Bldg. About $200,000. Noted July 10.

★**Va., Richmond**—Bank—First Natl. Bank, 9th and Main Sts., let contract building 4 story, brick, steel and stone, brick foundation, to J. T. Wilson, Mutual Bldg. About $75,000. Noted July 3.

★**Fla., Jacksonville**—Office—E. L. Hill Realty Co., 221 West Forsyth Ave., let contract building 6 or 7 story, 78 x 105 ft. rein.-con. and brick, to W. D. Gerbrich Co., 221 West Forsyth Ave. About $75,000.

★**O., Cleveland**—Office—Paul Bros., Citizens Bldg., let contract building 11 story, 56 x 134 ft., rein.-con., steel and brick, on East 6th St. and Vincent Ave., to Minnick Gibbons Co., Prospect Ave. About $750,000. Noted May 1.

★**O., Dayton**—Theatre—J. Seifert, South Jefferson St., let contract extending and remodeling Majestic Theatre, 2 story, to Nolan & Lester, City Natl. Bank. About $50,000. Noted Sept. 11.

★**O., Fletcher**—School—Bd. Educ., Brown Twp., let contract building 2 story, 70 x 110 ft., rein.-con. and brick, concrete foundation, to Knowlton Bros., Phillipsburg. About $70,000. Noted Aug. 21.

★**O., Lima**—Hotel—Cooperative Hotel Co. will build 10 story, 54 x 100 ft., steel, concrete, stone, terra cotta and brick. About $250,000. Work will be done by day labor.

★**O., West Park**—High School—Bd. Educ. let contract building 2 story, 90 x 90 ft. rein.-con., steel and brick, on Riverside Ave., to C. Peterson, Engineer's Bldg., Cleveland. About $60,000. Noted July 17.

★**Mich., Detroit**—Hospital—Grace Hospital, 277 West Grand Blvd., let contract building 3 story, 35 x 70 ft., rein.-con., brick and steel, rein.-con. and wood flooring, concrete foundation, on West Grand Blvd. and Lafayette St., to O. Misch Co., 831 Chamber of Commerce. About $60,000.

★**Mich., Pontiac**—Schools—Bd. Educ. let contract to W. H. Isgrigg & Son, Pontiac, building 10 room additions to McConnell and Baldwin Schools, rein.-con., brick and steel, concrete foundations, $119,000 and $110,000 respectively.

★**Ill., Chicago**—Bank—C. Hatzfield, archt., South Dearborn St., let masonry contract to A. V. Dacgling, 9000 Houston Ave., for 2 story, 35 x 90 ft. brick and terra cotta, concrete foundation, on 101st St. and Ewing Ave., for East Side Trust & Savings Bank, c/o architect. About $60,000. Noted Aug. 28.

★**Kan., Lorraine**—School—Bd. Educ. let contract building 2 story, 68 x 87 ft. rein.-con., steel and brick, concrete foundation, to Wichita Constr. Co., Wichita. About $51,000. Noted July 19.

★**Kan., Manhattan**—Engineering—State Bd. of Administration, Topeka, let contract building 3 story, 22 x 56 ft., and 50 x 112 ft., rein.-con., rein.-con. flooring, rock and concrete foundation, to J. M. Leeper, State House, Topeka, $168,662. Noted Sept. 4.

★**Neb., Valparaiso**—School—Bd. Educ. let contract building 1 story, 85 x 155 ft. rein. con., steel and brick, rein con. flooring, concrete foundation, to H. Ohlson & Sons Co., David City, $60,682. Noted Aug. 7.

★**Mo., St. Louis**—Store—Gubinsky Bros., Arcade Bldg., let contract building 2 story, 60 x 120 ft., also 3 story 75 x 120 ft., brick, steel and concrete, on Biddle St., to Herman Bldg. Co., 3800 Hartford St. About $50,000.

★**Okla., Alva**—Gymnasium—State Bd. Affairs, Oklahoma, let contract building 1 story, 71 x 180 ft., rein.-con., steel and brick, rein.-con. flooring, rock and concrete foundation, here, to Kreipke-Schaffer, El Reno, 15,600.

★**Okla., Claremore**—High School—City let contract building 3 story, 70 x 135 ft., brick and concrete, on Main St., to R. D. Pollard, Main St. About $95,000.

★**Okla., Oklahoma**—Church—First Church Christ, Scientist, let contract building 2 story, 90 x 100 ft., rein.-con., steel and brick, rock and concrete foundation, to E. P. Boyd, 1509 North McKinley St. Cost plus percentage basis. Noted Aug. 21.

★**Okla., Okmulgee**—Theatre—S. H. D. Cook let contract building 3 story, 52 x 141 ft., rein.-con., steel and brick, concrete foundation, to R. P. McClure Constr. Co., Kansas City, Mo. About $92,500. Noted Aug. 21.

★**Ore., Oregon City**—Hotel—J. Supple, 331 6th St., Portland, let contract building 3 story, 25 x 100 ft. rein.-con., concrete foundation, on Main and 4th Sts., to F. McIntosh, Oregon City. About $75,000.

Cal., Long Beach—School—Bd. Educ. received bids building 2 story, brick, concrete foundation, on American Ave., from J. D. Scherer, 1400 Elm St., $206,647; C. T. McGrew, 1340 Ocean Ave., $220,806; E. C. English, Long Beach, $232,500. Noted Jan. 30.

★**Cal., Los Angeles**—Studio—J. D. Hampton Productions Co., Hollywood, let contract to Milwaukee Bldg. Co., 316 Wright & Callender Bldg., building motion picture studio, on La Brea Ave. and Santa Monica Blvd., to consist of 50 x 220 ft. property room, 40 x 150 ft. office and three 120 x 120 ft. stages. About $250,000.

★**Cal., Los Angeles** — Studio — Paul Studios, Inc., Hollywood, let contract to E. Fossler, 6434 Hollywood Blvd., building motion picture studio on 20 acre site on Melrose and Crescent Aves. to consist of group of buildings to accommodate 30 producing companies, and central plant to serve all companies, including laboratories, one 100 x 480 ft. stage and three 100 x 350 ft. stages, etc. About $1,500,000 including equipment.

★**Cal., Los Angeles**—Studio—W. N. Selig let contract building picture producing plant to include offices, laboratory, dressing rooms, stages, etc., to Milwaukee Bldg. Co., 316 Wright and Callender Bldg. About $150,000. L. B. Mayer, lessee.

★**Cal., Pasadena** — Theatre — Pasadena Theatre Co., 67 North Raymond Ave., let contract building, 103 x 175 ft., rein.-con., on Raymond Ave., to W. C. Crowell, 440 Chamber of Commerce Bldg. About $200,000.

★**Cal., San Francisco**—Store—Imperial Realty Co., 709 Mission St., let contract building 6 story, rein.-con., on Geary St., to Barrett & Hilp, Sharon Bldg., about $150,000. Livingston Co., lessees.

★**N. B., St. John**—Nurses Home—Municipal Council let general contract building 3 story, 62 x 110 ft. addition to nurses home, at Genl. Pub. Hospital, to B. Mooney & Son, St. John, $143,368; plumbing and heating, to R. E. Fitzgerald, St. John, $15,780.

★**Ont., St. Catharines** — Schools — Bd. Educ. let contracts building two 2 story, brick, steel and concrete, concrete foundations, to W. W. Park, 49 Queen St., and F. C. Monk, Glen Ridge Ave., $58,510 each. Noted Aug. 21.

★**Sask., Saskatoon** — School — Bd. Educ. let contract building 3 story, concrete and steel, concrete foundation, to A. W. Cassidy, 1st St. About $90,000.

Federal Government Work

PROPOSED WORK

Md., Annapolis — Waterproofing — Spec. 4036—Bureau Yards & Docks, Navy Dept., Wash., D. C., plans to waterproof Terrace Roof and Bancroft Hall. About $60,000.

Ga., Douglas—Post Office—Treas. Dept., Wash., D. C., received no bids Sept. 10, building post office, here. J. A. Wetmore, superv. archt. Noted July 31.

O., Cincinnati—Lock and Abutment—U. S. Engr. Office, 1st Dist., Cincinnati, rejected bid received Aug. 1, building lock and abutment for Dam No. 24, Ohio River, near Chilo. Noted July 10.

BIDS DESIRED

Mass., Hingham—Dredging—Spec. 4031—Until Oct. 1, by Bureau Yards & Docks, Navy Dept., Wash., D. C., dredging at Naval Ammunition Depot, here. About $30,000; $10 deposit required for plans and spec. Noted Sept. 11.

Conn., New London — Dredging — Until Sept. 25, by U. S. Engr. Office, New London, dredging in Bridgeport Harbor.

N. Y., New York—Dredging—Until Oct. 6, by U. S. Engr Office, 39 Whitehall St., dredging and removing rocks in East River; advertised in this issue.

Pa., Phila.—Repairing Dyke—Until Oct. 15, by U. S. Engr. Office, repairing dyke at Bulkhead Bar in Delaware River; advertised in this issue.

Pa., Phila. — Sprinkler System — Until Sept. 30, by Officer in Charge of Constr., Frankford Arsenal, installing sprinkler system in Small Arms Ammunition Storehouse; advertised in this issue.

Md., Baltimore—Rip Rap—Until Sept. 22, by Lighthouse Supt., Baltimore, furnishing and placing rip rap around Wade Point Light Sta., N. C.

S. C., Charleston—Electric Lighting, Water Supply and Fire Protection Systems—Spec. 3977 A—Until Oct. 1, by Bureau Yards & Docks, Navy Dept., Wash., D. C., installing, here. About $30,000; $10 deposit required for plans and spec.

Ala., Florence—Derricks—Until Oct. 15, by U. S. Engr. Office, furnishing and erecting 3 steel traveling tower derricks; advertised in this issue.

N. D., Bismarck—Quarters and Mess Hall—Until Oct. 15, by Dept. Interior, Office of Indian Affairs, Wash., D. C., building brick employees' quarters and brick mess hall, here. C. Sells, comr.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★**Mass., Boston**—Wharf—U. S. Engr. Office, Boston, let contract building pile wharf at Hog Island, to Lawler Bros., Charlestown, $22,815. Noted July 31.

R. I., Newport—Structural Steel—Spec. 4023—Bureau Yards & Docks, Navy Dept., Wash., D. C., received bids Sept. 10, furnishing structural steel for Emergency Torpedo Repair Shop, here, from Amer. Bridge Co., Wilkins Bldg., Wash., D. C., $12,850 (90 days); J. Eichleay, Jr. Co., South 20th and Horton Sts., Pittsburgh, Pa., $12,610 (120 days); J. E. Ogden, 147 Cedar St., New York City, $18,634 (90 days). Noted Sept. 4.

Federal Government (Continued)

Conn., New Haven—Pumps—Superv. Archt., Treas. Dept., Wash., D.C., received bids Sept. 12, installing motor driven triplex pumps in Post Office, here, from J. R. Proctor, 74 Courtlandt St., New York City, $1465; J. D. Kelly, 93 Meadow St., $1861; E. S. Downs Co., 756 Broad St., $2414. Noted Aug. 21.

★**Md., Aberdeen**—Road Work—J. D. Moon, constr. officer, Aberdeen Proving Ground, let contract building 5 mi. concrete roads, 16 and 20 ft. wide, in Aberdeen Reservation, to Claiborne, Johnston & Co., 910 Garrett Bldg., Baltimore. Noted Aug. 21.

D. C., Wash. — Damp-Proofing — Treas. Dept. received bid Sept. 9, damp-proofing Northwest Storeroom in Sub-Basement of new Treasury Annex, from W. B. Avery, 632 G St., N. W., $2369 (90 days). Noted Sept. 4.

S. C., Charleston—Mechanical Stokers—Spec. 4010—Bureau Yards & Docks, Navy Dept., Wash., D. C., received bids Sept. 10, installing in Power Plant, here, (1) work complete, from Westinghouse Electric & Mfg. Co., Hibbs Bldg., Wash., (1) $10,391 (time as specified); Sanford Riley Stoker Co., 25 Foster St., Worcester, Mass., (1) $14,520 (75 days); Amer. Engr. Co., Aramingo and Cumberland Sts., Phila., (1) $15,450; (2) $15,755 (75 days). Noted Aug. 28.

Fla., Pensacola—Removal of Pier—Bureau Yards & Docks, Navy Dept., Wash., D. C., received bids removing seaplane pier No. 186, (1) work complete, from Southern Constr. Co., Brent Bldg., (1) $5366, (2) $4995 (27 days); C. H. Turner, Pensacola, (1) $5793, (2) $4993, (45 days). Noted Aug. 14.

★**Miss., Vicksburg**—Levee Work—U. S. Engr. Office, 3rd Dist., Vicksburg, let contract building levee work, here, to Roach, Stansell Lawrence Bros., North Memphis Savings Bank Bldg., Memphis, Tenn., $67,500. Noted July 24.

Montana—Road Work—Bureau Pub. Rds., U. S. Dept. of Agriculture, Missoula, received bids Aug. 30, grading 3.6 mi. Glacier Park National Forest Rd., 12 ft. wide, from L. Callison, Cut Bank, $16,998; White, Brown & Leahy, Great Falls, $20,-472; Rich & Markhus, Prosser, Wash., $20,799. Noted Aug. 21.

Wash., Newport — Road Work — Bureau Pub. Rds., Missoula, Mont., received bids Aug. 30, grading 11.91 mi. Mataline National Forest Rd., 12 ft. wide, Pend O'Reille Co., from Rich & Markhus, Prosser, $76,-111; A. Clifton, Applegate & Toole, Hutton Bldg., Spokane, $88,169. Noted Aug. 14.

Miscellaneous

PROPOSED WORK

Coal Bunkers—Waterbury Conn.—Waterbury Clock Co., 31 Cherry Ave., soon receives bids building brick and concrete coal bunker. About $10,000. Private plans.

Garbage Incinerating Plant—Paterson, N. J.—City plans to build addition or build new garbage incinerating plant. H. J. Harder, city engr.

Park—Trenton, N. J.—City plans to lay out park on Commercial Ave., along Delaware River, 18 ft. wide various lengths. J. W. Thompson, Broad St. Bank Bldg., engr.

Coal Breaker—Carbondale, Pa.—Murrin Coal Co., Fallbrook St., having sketches prepared by G. A. Westcott 119 Wyoming Ave., Scranton, for 500 ton capacity coal breaker, 85 ft. high. About $35,000.

Swimming Pool—Phila., Pa.—Nicetown Boys' Club, Clarissa St. and Hunting Park, plans to build 30 x 100 ft. About $50,000. Archt. not selected.

River Front Improvement—Shreveport, La.—City plans to improve river front preparatory to installing river rail terminals. Plans have been prepared for revetment by use of mattress and bank paving of about 3000 lin ft. of river front and pumping about 500,000 yd. river sand behind revetment for land reclamation; revetment of at least 1000 ft. river front requiring 60,000 sq ft. mattress work and 60,000 sq. ft. riprap bank paving will probably be done in fall. C. E. Smith & Co., 2071-2074 Ry Exch. Bldg., St. Louis, Mo., engrs.

Cast Iron Pipe — Detroit, Mich. — City soon lets contract furnishing f.o.b. Detroit, 1500 tons 24 in., 500 tons 16 in., 1500 tons 6 in. and 1500 tons 8 in. c.i. water pipe, also special castings for c.i. pipe, tapping sleeves and gates. T. H. Leisen, 232 Jefferson Ave., engr.

Gate Valves—Detroit, Mich.—J. A. Martin, comr. purchases and supplies, Municipal Courts Bldg., soon lets contract furnishing three hundred 6 in., two hundred fifty 8 in., twenty-five 10 in., one hundred 12 in., thirty 16 in., twenty 24 in., five 30 in., five 36 in., five 42 in. and four 48 in. gate valves for Bd. Water Comrs. G. H. Ferbell, 232 Jefferson Ave., engr.

Railway Tracks, etc.—St. Louis, Mo.—See "Industrial Works."

Pavement—Belton, Tex.—City soon lets contract for 22,500 sq yd. pavement. Alternate bids on bitulithic asphaltic concrete, Topeka top, 1 and 2 course concrete. H. R. Smith, Belton, engr.

Park—Billings, Mont.—City election Sept. 30, to vote on $75,000 bonds to improve park. E. M. Sneckenberger, city engr.

BIDS DESIRED

Miscellaneous Supplies—New York, N. Y.—M. Hausle, engr., 3307 3rd Ave., is in the market for heaters, mixers, tanks, conveyors, motors, boilers, cranes, elevators dust collectors and derricks, to be installed in asphalt plant. Owner's name withheld.

Garbage Incinerator, etc.—Monessen Pa.—Until Sept. 24 by J. E. Pittman, boro. secy., constructing brick building, chimney foundations, concrete foundations, coal house, concrete culvert and wooden trestle for garbage incinerating plant. Chester & Fleming, Union Bank Bldg., Pittsburgh, engrs.

Pumping Equipment—Los Angeles, Cal.—Until Oct. 6, by H. B. Ferris, secy. Bd. Pub. Wks., furnishing pumping equipment for Manchester Ave. sewage pumping plant. A. C. Hansen, city engr.

Lock, Dam, etc.—Bobcaygeon, Ont.—Until Sept. 29, by Dept. Rys. & Canals, Ottawa, building lock rein.-con. dam, swing bridge, rein.-con. drydock, wheel pit, tail race, long wing wall, slopes and macadam roads, in connection with Trent Canal here. About $350,000. W. A. Bowden, care of Dept. Rys. & Canals, engr.

Wharf—Quebec—Until Oct. 2, by Dept. Pub. Wks., Ottawa, Ont., building extension to wharf at Notre Dame des Sept Douleurs, 30 x 80 ft. About $11,000. E. Lafleur, care of Dept. Pub. Wks., engr.

Wharf—St. Laurent de Orleans, Que.—Until Oct. 2, by Dept. Pub. Wks., Ottawa, Ont., repairing wharf here, timber with stone fill, concrete roadway, 180 ft. long, 36 ft. wide and 60 x 70 ft. Work involves 170 cu. yd. concrete. About $15,000. E. Lafleur, care of Dept. Pub. Wks., engr.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★**Foundations, etc.—Bridgeport, Conn.**—Fletcher-Thompson, Inc., engrs., 1089 Broad St., let foundation and excavation contracts for proposed 7 story, 100 x 150 ft., cold storage plant and 1 story, 65 x 100 ft. and 60 x 65 ft. warehouse, brick and rein.-con., rein.-con. flooring, concrete foundation, for Peoples Ice & Cold Storage Co., 1335 Seaview Ave., to T. J. Pardy Constr. Co., 1487 Seaview Ave. About $25,000. Noted Sept. 11, under "Buildings."

★**Retaining Wall—Thompsonville, Conn.**—Bigelow-Hartford Carpet Co., 58 Main St. let contract building 730 ft. concrete and stone retaining wall along power house and Connecticut River, to D. O'Connell Son, 480 Hampden St., Holyoke, Mass. About $40,000.

★**Drilling — Harrisburg, Pa.** — State Bd. Control let contract drilling foundation of new capitol building, to Acker Drilling Co., Mears Bldg., Scranton. About $12,000.

Superstructure, etc.—Phila., Pa.—Dept. City Transit received bids for completion of steel superstructure and appurtenance work of Frankford Elevated Ry., in Front St. near Arch St., Contr. No. 509, including (a) whole work as shown on plans, (b) 100,000 lb. riveted steel girders, (c) 1000 lb. rolled steel beams, (d) 10,000 lb. steel columns, (e) 100 lb. steel reinforcing rods, (f) 1000 lb. iron castings, from McClintock Marsall Co., Morris Bldg., (a) $21,535, (b) $.069, (c) $.053, (d) $.0715, (e) $.056, (f) $.105; Phoenix Bridge Co., Phoenixville, (a) $31,626, (b) $.0674, (c) $.0574, (d) $.07, (e) $.06, (f) $.085.

★**Reconstruction of Flooring—Pittsburgh, Pa.**—Dept. Pub. Wks. let contract reconstructing wood roadway flooring of Wilmont St. Bridge over Cunliffe Hollow, to J. T. Barr, Walsh Bldg., $11,977. Noted Sept. 11 under "Bridges."

★**Pier — Baltimore, Md.** — Weyerhauser Timber Co., 1015 Lexington Bldg., let contract building one 40 x 680 ft., wood pile and timber pier on water front near Curtis Bay, to Empire Eng. Co., Inc., 103 Bourse Bldg. Cost between $25,000 and $30,000. Noted Aug. 14.

★**Pier — Dayton, O.**—City let contract furnishing 233 tons c.i. water pipe, to Moraine Development Co., Moraine City, $11,020.

★**Roof and Trusses—Detroit, Mich.**—City Water Comn., 232 Jefferson Ave., let contract building, 67 x 307 ft., roof with 76 ft. steel roof trusses over engine room in pumping station, to Wisconsin Bridge & Iron Co., 1362 Penobscot Bldg. About $62,-000. Noted Aug. 21.

Charging Platform, etc.—Ypsilanti, Mich.—Central Specialty Co. let contract for steel work, 40 x 50 ft., concrete and steel charging platform, and 5 ton yard crane with runway, 45 ft. span 100 ft. length, to Amer. Bridge Co., Beecher and Michigan Central Ry., Detroit; electric mono rail equipment, to Sprague Electric Co., 40 Larned St., Detroit. Platform and footings to be built by owner.

★**Steel-Barton, Wis.**—Stevens Mfg. Co. let contract furnishing reinforcing steel, structural steel and Class "A" concrete for proposed factory, to P. J. Kalman Co., 425 East Water Street., Milwaukee. About $11,-900. Noted Aug. 21 under "Industrial Works."

★**Foundation—St. Louis, Mo.**—United Drug Bldg. Co., 3rd Natl. Bank, let contract building concrete foundation for 6 story, 60 x 235 ft. factory, at 3908-45 Kingshighway, to Westlake Constr. Co., 717 Locust St. About $40,000.

★**Stages—Los Angeles, Ca.**—See "Buildings."

TRACK WORK—PHILADELPHIA, PA.

Bids were received by Department of City Transit, 1211 Chestnut St., for track work for Frankford Elevated Ry, from (A) Snare & Triest, Penn. Bldg., (B) M. & J. B. McHugh, 892 North Markoe St.; (C) North Amer. Ry. Contg. Co., 1320 Monadnock Bldg., Chicago. The unit bids were as follows:

	A	B	C
20,400 lin ft. unballasted track straight or curved to radius of 500 ft. or over	$7.30	$9.10	$8.72
36,900 lin ft. ballasted track, straight or curved to radius of 500 ft. or over	4.90	4.95	5.55
16,000 tons ballast (per ton of 2000 lb.)	4.40	5.50	5.19
Crossovers No. 8 in place complete (lump sum)	5,200.00	5,000.00	6,499.00
Reinforced-concrete floor and curve between bents 228 and 238 (lump sum)	18,000.00	22,000.00	20,829.00
Track between bents 503 and 512, except ballast (lump sum)	8,500.00	7,500.00	10,392.00
Track between bents 526 and 532, except ballast (lump sum)	5,000.00	5,000.00	5,964.00
Filling all bit cup recesses in footwalk slabs over fastening bolts (lump sum)	2,000.00	2,000.00	1,113.00
500 ft. single track 90 lb. rail with all appurtenances	1.30	1.55	2.00
100 tie blocks for 2 ft. 10 in. creosoted tie blocks	1.50	1.98	2.21
8 in. creosoted ties for ballasted track	3.20	3.90	5.86
For cast iron rail braces, per lb.	.20	.10	.10
For 1:2:4 concrete per cu. yd.	25.00	25.00	15.00
For steel imbedded in concrete, per lb.	.05	.08	.10
For substituting continuous T rail joints 24 in. long	1.90	2.25	2.79
For substituting continuous T rail joints 38 in. long	5.00	4.00	5.60
For bumping posts	450.00	250.00	350.00
For force account labor and material	10%	10%	10%
Extended totals	$462,010	$521,828	$539,339